EFFECTS OF PRIMING AND SALT STRESS ON GROWTH, YIELD AND NUTRIENT UPTAKE OF WHEAT GENOTYPES

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EFFECTS OF PRIMING AND SALT STRESS ON GROWTH, YIELD AND NUTRIENT UPTAKE OF WHEAT GENOTYPES

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CERTIFICATE

This is to certify that the thesis entitled ***"Effects of priming and salt stress on growth, yield and nutrient uptake of wheat genotypes"*** *submitted to the Department of Agronomy, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of* ***Master of Science*** *in* ***Agronomy****, embodies the result of a piece of bonafide research work carried out by* ***Monalisa****, Registration No.* ***17-08306*** *under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

I further certify that any help or source of information, received during the course of this investigation has duly been acknowledged.

Dated:
Dhaka, Bangladesh

____

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Dedicated To

My Beloved Parents

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EFFECTS OF PRIMING AND SALT STRESS ON GROWTH, YIELD AND NUTRIENT UPTAKE OF WHEAT GENOTYPES

ABSTRACT

A three factor experiment was conducted at the field of Department of Agronomy, Sher-e-Bangla Agricultural University (SAU), Sher-e-Bangla Nagar, Dhaka-1207 during the period from November 2017 to June 2018 to evaluate the growth, yield and nutrient uptake of three wheat genotypes under priming and salt stress condition. The experiment was laid out in a split-split plot design with three replications. The factors were- Factor A: variety- 3 levels *viz.* V_1= ESWYT 5, V_2= ESWYT 6 and V_3= BARI Gom 28; Factor B: salt stress- 3 levels *viz.* S_0= no salt, S_1= 10 dS m^{-1} and S_2= 15 dS m^{-1} and Factor C: priming agent- 3 levels *viz.* P_0= without priming, P_1= 5% Polyethylene glycol (PEG) and P_2= 2% Mannitol. Polyethylen glycol (PEG) and Mannitol were used as priming chemicals and salt (NaCl) was used for salinity stress. The data on soil sample, plant sample, growth and yield contributing characters and nutrient uptake pattern attributes were measured and analyzed using a computer software statistix-10. The significance of difference among the treatments means was estimated by the least significance difference at $LSD_{0.05}$. The results showed that among the varieties, V_1 (ESWYT 5); among salt stress levels, no salt (S_0); P_1 (5% PEG) among priming agents showed the best findings. In case of different treatment interactions, however, V_1S_0 (ESWYT 5 × no salt), V_1P_1 (ESWYT 5 × 5% PEG), S_0P_1 (no salt × 5% PEG) and $V_1S_0P_1$ (ESWYT 5 × no salt × 5% PEG) showed the best performances in terms of all the growth, yield and nutrient uptake parameters studied. The worst performance was recorded from V_3 (BARI Gom 28), S_2 (15 dS m^{-1}), P_0 (without priming), V_3S_2 (BARI Gom 28 × 15 dS m^{-1}), V_3P_0 (BARI Gom 28 × without priming), S_2P_0 (15 dS m^{-1} × without priming) and $V_3S_2P_0$ (BARI Gom 28 × 15 dS m^{-1} × without priming) in all the parameters examined. In the experiment, the interactions $V_1S_0P_1$, followed by $V_1S_0P_2$, $V_1S_1P_1$ and $V_1S_1P_2$ performed well which may be recommended for the saline affected area in Bangladesh.

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SOME COMMONLY USED ABBREVIATIONS

Abbreviations	Full meaning	Abbreviations	Full meaning
AEZ	Agro-Ecological Zone	P	Phosphorus
Agric.	Agricultural	ml	Millilitre
BBS	Bangladesh Bureau of Statistix	No.	Number
BCSIR	Bangladesh Council of Scientific and Industrial Research	PEG	Polyethylene glycol
cm	Centimeter	SAU	Sher-e-Bangla Agricultural University
CV	Coefficient of Variation	var.	Variety
DAS	Days after sowing	^{0}C	Degree celcius
df	Degrees of freedom		
e.g.	*exempli gratia* (for example)	NaCl	Sodium chloride
et al.,	And others	%	Percent
etc.	etcetera	mg	Milligram
FAO	Food and Agriculture organization	K	Potassium
gm	gram	Ca	Calcium
i.e.	id est (L), that is	L	Litter
IAA	Indole Acetic Acid	CCC	Chlorocholine Chloride
KCl	Potassium Chloride		
Kg	Kilogram (s)	J.	Journal
LSD	Least Significant Difference	SS	Sum square
m^2	Meter squares		
MS	Master of science	Meq.	Milli-equvalent
ppm	Parts per million		
Res.	Research	OC	Organic carbon
viz.	*Videlicet* (Namely)	GM	Geometric mean

INTRODUCTION

Wheat (*Triticum aestivum* L.) is considered as one of the predominant cereal crops under the Poaceae family that occupies global rank one in respect of worldwide production and consumption. It is the staple food of more than 36% of world population that supplies nearly 55% of the carbohydrates and 20% of the food calories consumed as human diet globally (CIMMYT, 2018). Around the world, about 30% area is covered by wheat cultivation (El-Keblawy and Al-Rawai, 2006). In 2016, world wheat production was 749 million tons, which made it the second most produced cereal after maize (1.03 billion tons) (FAO, 2016). In Bangladesh it is the second most significant grain crop after the staple grain rice. The national wheat production during the year 2016-2017 was 1.422 million metric tons from 0.429 million hectares of cultivated land with an average 3.32 metric t ha^{-1} while in 2015-2016 it was 1.348 million metric tons from 0.445 million hectares of cultivated land with an average of 3.03 metric t ha^{-1} (BBS, 2017). However, the wheat yield of Bangladesh is much lower comparing the rest other wheat producing countries in the world due to the fact of growing wheat under rainfed condition (Ashraf, 2005). Estimated world population by 2050 will be around 9-10 billion which will require double the existing food production in order to feed this vast population (Rahman *et al*., 2013). Variety is an important factor affecting farmer's yields and is also among the factors given the highest priority for immediate technology transfer. Diffusion of new varieties ensures continuing increase in productivity through the increased yield potential of new varieties; It reduces the investment, thereby increasing the returns and helps to maintain genetic resistance to diseases and pests (Petersen and Shireen, 2001).

Salinity is one of the most important environmental stresses which severely limit plant growth and productivity worldwide. Wheat is cultivated over a wide range of environments, because of wide adaptation to diverse environmental conditions. It is a moderately salt-tolerant crop (Moud and Maghsoudi, 2008). It is a suited crop for saline soils because it required irrigation water, which is necessary for reclamation of saline soils. Soils are considered saline if they contain soluble salts in quantities sufficient to interfere with the growth of most crop species. Salinity is a major threat to crop productivity in the southern and south-western part of Bangladesh, where it is developed due to frequent flood by sea water of the Bay of Bengal and on the other hand intrusion of irrigation with saline waters. The coastal region covers almost 29,000 km^2 or about 20% of the country and 30% of the cultivable lands of the coast. About 53% of the coastal areas are affected by different degree of salinity. More than 1 million hectares of the coastal areas have been seriously affected by salinity (Rahman *et al.*, 2008), which is considered as one of the major problems of crop production in Bangladesh. The problem is ever increasing because of irrational human acts causing secondary salinization and climatic change with consequent rise in sea level.

Introduction of wheat into the existing cropping pattern in the saline soil may become a worthy effort to utilize these lands to meet up the food and nutritional balance of the over increasing population of Bangladesh. Saline soil covers our earth's surface, estimated to be from 400 to 950 million ha. The total world wide area of land affected by salinity is about 190 million ha (FAO, 2010). It has been demonstrated that about 61% reduction of seed germination and 23- 25% yield loss can be occurred when wheat seed were cultivated under salt stress condition (Al-Musa *et al*., 2012). Poor germination and seedling establishment are the results of soil salinity. It is an enormous problem adversely affecting growth and development of crop plants and results into low agricultural production. Salinity causes a variety of biochemical, physiological, and metabolic changes in most of the crop plants which may result in oxidative stress and affect plant metabolism, stand establishment and thereby the yield (Tamamm *et al.*, 2008).

Seed priming is considered as a promising approach to increase stress tolerance capacity of crop plants including salinity. It has been found to be a reliable technology to enhance rapid and uniform emergence, high vigor, and better yields for vegetable and field crops (Rouhi *et al.*, 2011). In fact, this technique is a treatment that applied before germination in a specific environment that seeds are partially hydrated to a point where germination processes begin but radical emergence does not occur (Wahid *et al*., 2007). Seed priming can be accomplished through different methods such as hydropriming (soaking in DW), osmopriming (soaking in osmotic solutions such asmannitol, PEG, potassium salts, e.g., KCl, K_2SO_4) and plant growth inducers (CCC, Ethephon, IAA) (Turki *et al*., 2012). Growth regulator has been reported successively on regulating various biological processes, including root formation (Zheng *et al.*, 2013), flowering and fruit ripening (Shirazi *et al*., 2001), and leaf senescence (Wang *et al*., 2008). Polyethylene glycol (PEG), being a high molecular weight ostmotic substance, has been used frequently as artificial stress inducer in many studies (Flowers, 2004).Kalhoro *et al.*, (2010) have also studied the effect of PEG induced stress on physio-hormonal attributes of wheat. Due to many reasons, PEG is considered superior to other solutes to induce different stress (Kaur *et al*., 2005).

Therefore, considering the above fact, the present study was focused evaluation of wheat genotypes by imposing different concentration of priming agents and salt stress with the following objectives

i) To evaluate the effect of different priming agents on germination, growth, yield and nutrient uptake pattern of wheat genotypes.
ii) To evaluate the interaction effect of priming agent and variety on growth and yield of wheat under salt stress.
iii) To quantify grain yield of wheat under salt stress.

REVIEW OF LITERATURE

Wheat is an important food crop in our country. Most of the areas of the southern part of Bangladesh are affected by salt condition and farmers cannot cultivate wheat in the salt affected area due to lack of efficient salt tolerant variety or lack of proper management strategy. Again, priming of seeds can reduce the water requirement and increase total productivity of crops. In regions where water is scarce people have to grow wheat as it requires much less water than boro rice. Salinity stress is one of the most deleterious abiotic stresses reducing crop production across the world. It is one of the most important stresses limiting crop production in arid and semiarid regions (Iqbal and Ashraf, 2005) and it is a great problem in the coastal region of Bangladesh, where a vast area remains fallow for long time. Wheat is an important cereal crops in Bangladesh and it is a great source of carbohydrate and protein. The scientists are conducting many experiments to adopt different crops in the saline area; wheat is one of them. Some of the countries like Australia, USA, Bangladesh, Pakistan, Sri Lanka etc. are having acute problem with the management of salinity and sustainable crop production. However, soil salinity is not harmful in similar manner for all wheat cultivars. Genetic improvement of salinity tolerance in crop plants is of high importance throughout the world. Very limited research works have been conducted to adapt wheat in the saline area of Bangladesh. An attempt has been made to find out the performance of wheat at different levels of salinity.To facilitate the research works, different literatures have been reviewed in this chapter under the following headings.

2.1 Effects of priming on different wheat genotypes

Toklu *et al*. (2015) conducted an experiment to determine the effect of some priming treatments on seed germination properties, grain yield, and several agro-morphological characteristics of bread wheat. Two commonly grown bread wheat varieties, namely Adana-99 and Pandas, were selected for experimentation conducted during the 2007–08 and 2008–09 growing periods. The seeds of the Adana-99 and Pandas wheat varieties were primed with the following: (1) distilled water, (2) 100 ppm indole-3-acetic acid (IAA), (3) 2.5% potassium chloride (KCl), (4) 1% potassium dihydrogen phosphate (KH2PO4), (5) 10% polyethylene glycol (PEG-6000), or (6) gibberellic acid (GA3, used only for field experiments). Non-primed seeds were used as the control group. First 1000 mL of priming media was prepared for each priming treatment, and seeds of both varieties were rinsed in the solution for 12 h at room temperature. Germination percentage at two different temperatures (10 °C and 20 °C), coleoptile length, seedling emergence percentage, and seedling growth rate were evaluated under laboratory conditions. Primed seeds of both varieties were sown on two different dates under field conditions to evaluate certain agromorphological characteristics. PEG, IAA, and distilled water treatments increased seed germination percentage, seedling emergence percentage, and seedling growth rate. PEG, KCl, and hydropriming treatments increased grain yield compared to the control. Among the different priming agents used in the study, PEG, KCl, and hydropriming were the most effective treatments to attain higher germination percentage and grain yield.

An experiment was conducted to investigate the interactive effect of salinity and seed priming on barely genotypes at the Institute of Biotechnology and Genetic Engineering (IBGE), Khyber Pakhtun Khwa Agricultural University Peshawar Pakistan. The experiment was carried out in completely randomized design (CRD) with three replications consisting of twelve barely genotypes (Haider-93, Soorab-96, Arabic Asward, NRB-37, Frontier-87, Jau-83, Balochistan-Local, NRB-31, KPK-Local, Sanober-96, Awarn-2002 and AZ-2006) at two seed conditions (seed priming with 30 mM NaCl or no seed priming) under four salinity levels (0, 50, 100 and 150 mM). The results revealed that seed priming and salinity had significantly ($p \leq 0.05$) affected all the parameters under study. However, the effect of seed priming was non significant ($p > 0.05$) on shoot chlorophyll a content (mg g -1 fresh weight) and root sugar content (mg g -1 dry weight). Salinity stress had adversely affected growth and biochemical parameters of barley genotypes, however, seed priming with NaCl had diminished the negative impact of salt stress. Maximum shoot dry weight plant -1 (1.81 g), root dry weight plant^{-1} (0.42 g), shoot K + content (1.41 mg g^{-1} dry weight), root sugar content (7.55 mg g^{-1} dry weight) were recorded in Balochistan-Local. Similarly, Haider-93 produced highest root K + content (0.67 mg g^{-1} dry weight), shoot sugar content (16.36 mg g^{-1} dry weight), shoot chlorophyll a content (3.44 mg g^{-1} fresh weight) and shoot chlorophyll b content (1.78 mg g^{-1} fresh weight). Maximum shoot Na^+ content (1.20 mg g^{-1}) and root Na^+ content (1.47 mg g^{-1}) was recorded in Frontier-87. Seed priming had significantly ($P < 0.05$) enhanced all the aforementioned parameters. The positive effect of seed priming was more profound in Balochistan-Local followed by Haider-93 as compared to other genotypes. (Sun *et al., 2010)*

.Talebian *et al*. (2008) conducted an experiemnt to evaluate the effects of seed pyridoxine-priming duration on germination and early seeding growth characteristics of two wheat genotypes included inbred lines of PBW-154 and PBW-343. The experiments were carried out in completely randomized design (CRD) with five seed priming treatments in three replications. The seed priming treatments included three pyridoxine-priming duration treatments consist of 6, 12 and 24 h were compare with the unsoaked seed control and a hydro-priming with distilled water for 12 h. The pyridoxine concentration of 200 mg 1-1 prepared in distilled water was used as pyridoxine-priming media. Seed pyridoxine-priming treatments improved seed germination and early seeding growth traits included germination percentage, coleoptiles and radical length, seeding dry matter accumulation, mean germination time (MGT), germination index (GI), vigor index (VI), and time to 50% germination (T50) of both genotypes. Seed pyridoxine priming duration of 12 h produced maximum value for most of the germination and early seedling growth characteristics of wheat inbred lines of PBW-154 and PBW-343. These results have practical implications in the pre-sowing seed treatment with pyroxene solution could enhance the seed germination and early seedling growth characteristics of wheat plant.

2.2 Effect of priming on growth and yield contributing parameters

Farooq *et al.* 2(007) conducted an experimental the experiment comprising of eight treatments: Control (T_1), hydro priming (T_2), 10µg/ml $CoCl_2$ (cobalt chloride) priming (T_3), 15µg/ml $CoCl_2$ priming (T_4), 1.0% Potassium nitrate (KNO_3) priming (T5), 2.0% Potassium nitrate (KNO_3) priming (T6), 0.5% CaCl2 (calcium chloride) priming and 1.0% $CaCl_2$ priming (T8). Results revealed that the treatment T4 (15µg/ml $CoCl_2$ priming) and T6 (2. 0% KNO_3) after 24 hours of priming were at par in re spect to seedling length (238 and 240), seedling fresh weight (172 mg and 168 mg) and seedling vigour index 22610 and 22800) in the laboratory experiment. Mean days to ger mi nation (MDG) also re duced in all the treatment than control. In the field experiment, 12 hrs seed priming with 15µg/ml $CoCl_2$ and 2.0% KNO_3 gave significantly higher grain yield than con trol and harvest index 37.45 and 32.2 than control (31.41). The increase of 19.98% and 18.3% grain yield with 15µg/ml $CoCl_2$ and 2.0% KNO_3 was observed in 12 h seed priming. However, water priming (T_2) and CaCl2 0.5% priming (T_7) reduced the grain yield than control in 24 hrspriming. From the present study, it may be concluded that 12hrs seed priming is useful to enhance uniform seed ling emergence and to enhance grain yield in wheat. Farooq *et al.* 2007

2.3 Salinity effects on plants

Podmore (2009) stated that "an excess of some salts can cause an imbalance in the ideal ratio of salts in solution and reduce the ability of plants to take up nutrients. For example, relatively high levels of calcium can inhibit the uptake of iron ('lime induced chlorosis), and high sodium can exclude potassium". The result of these effects lead to plant death due to severe growth retardation and molecular damage. Plants are affected by salinity in different ways such as osmotic effect, toxic effect and ionic imbalance (Lauchli and Epstein 1990, Munns 2005, Podmore 2009). Osmotic stress is due to the presence of ions mainly Na^+ and Cl^- in the soil which limits the availability of water to the plant. On the other hand, excess accumulation of these ions in leaves leads to ion toxicity.

Plants are divided into halophytes and non-halophytes (glycophytes) depending on their response to salinity. Halophytes grow in high salt soils, for example marsh grass (the most tolerant one will continue to grow at concentrations of NaCl in the 200 to 500 mM range), while glycophytes such as beans, rice and maize can tolerate very little salt and may suffer irreparable damage at concentration of NaCl less than 50 mM (Hopkins and Huner, 2004).

2.4 Effects of salinity on different wheat genotypes

Kahrizi *et al.* (2013) conducted an experiment based on completely randomized design with three replications because of importance of durum wheat in human nutrition, identification of morphological and agronomic traits affecting tolerance to salt stress in order to use in selecting tolerant cultivars is essential. Treatments were salinity with three levels as control, 60 and 120 mM and ten durum wheat cultivars including Boomer, PGS, 71135, 61130, 605, C1351, KND, KDM, Haurani and

G1252. Results showed that interaction of salinity and cultivars was only significant for number of grains per spike and grain weight per spike. It means that any stress during vegetative growth stages can affect yield through reduction in source to sink ratio. Boomer was the tolerant cultivar in all salinity levels according to final grain weight and C1351 was the most sensitive one. On the other hand, PGS can be grown under sever saline soils because of it high performance under salinity, but under normal conditions does not produce high yield.

It was reported that Salinity is a big constraint to crop quality and production. The major wheat growing region of the world, wheat growth, yield and quality are affected by salinity. To solve this problem it is necessary to breed tolerant varieties through selection and breeding techniques. An experiment was conducted to determine the salinity impact on grain yield, protein content and thousand kernel weight among 55 varieties and accessions of common and durum wheat (16 winter wheat varieties and 39 spring wheat accessions). The results showed that salt treatment (100 mM of NaCl solution) depressed growth and yield production in 45 common and durum wheat varieties. While 6 varieties of durum wheat, 3 accessions of durum wheat and 1 accession of common wheat were insignificantly affected by salinity. The decrease in grain yield might be caused by the salinity, which induced reduction of photosynthetic capacity leading to less starch synthesis and accumulation in the grain. In addition the results showed that winter wheat is more tolerant to salt stress than spring wheat and that durum type of wheat showed more tolerance than common wheat. Thousand kernel weight also decreased in all 10 varieties and accessions regardless of the species by salinity effect Turki *et al*., (2012).

El Hendawy *et al.* (2011) proved that salinity did not affect final germination percentage, while seeds subjected to 80 and 160 mM Nacl treatment. Salinity affected shoot growth more severely than root growth of seedlings. Height and dry weight of shoot of the genotypes ranked in the same order as their salt tolerance ranking in terms of grain yield, whereas root dry weight did not. So, the measurement of shoot growth may be one of the effective criteria for screening wheat genotypes for salt tolerance at early growth stages.

Barma *et al.* (2011) reported that two lines named BARI GOM 25 and BARI GOM 26) were selected for commercial production in the southern belt. BARI GOM 25 showed a good level of tolerance to salinity. Hameed *et al.* (2009) conducted an experiment with two wheat genotypes differing in salt tolerance and observed that the 3 days old wheat seedlings were subjected to 5, 10 and 15 dS m^{-1}NaCl salinity for 6 days, application of low salinity (5 dS m^{-1}) growth was suppressed even in tolerant genotype. The cv. Lu-26, exhibited a better protection mechanism against salinity as indicated by lower salt induced proteolysis, higher biomass accumulation and protein contents than the relatively sensitive cv. Pak-81. Datta *et al*. (2009) undertook an experiment with five varieties of wheat viz., HOW234, HD-2689, Raj-4101, Raj-4123, and HD-2045 varying the salinity levels to (0, 25, 50, 75, 100, 125, 150 mM NaCl). They observed that different level of salinity significantly affected the growth attributes by reducing root and shoot length for 6 salinity below 125 mM. Fresh weight and dry weight of root and shoot were reduced significantly with subsequent treatment. Maximum germination was found in variety HD2689 in all the treatments and maximum inhibition was found to be in case of HOW234 variety at 150mM salinity level.

Rahman et al. (2008) conducted an experiment with four cultivars of wheat *(Triticum aestivum* L.*)* to NaCl salinity treatments measuring 0.00, -2.457, -4.914, and -14.742 bars at germination and early seeding growth stage. They observed that water uptake and germination decreased in all cultivars. Increased salt concentration also affected the early seedling growth. Among the cultivars under investigation Zarlasht cultivar appeared to be more sensitive at germination stage. Tammam *et al.* (2008) conducted a pot experiment with salt tolerance wheat cv. Banysoif-1. Seedlings were irrigated by different saline waters (0, 60,120,180,240 and 320 mM NaCl). They observed that fresh and dry weight of roots was unchanged up to the level of 120 mM NaCl then a significant reduction obtained at 240 and 320 mMNaCl. In shoots and spikes, dry matters were either unchanged or even stimulated to increase toward 180 mM NaCl then a quick reduction was observed.

Akram *et al*. (2002) conducted an experiment for the screening of wheat and wheat Thinopyrumamphiploids and in the experiment it was possible to produce good yields under saline and water logged conditions. Rajpar and Sial (2002) conducted a pot experiment with eight varieties of wheat such as Khar-chia-65, Anmol, NIAB-20, PAI-81, TW161, Bakhtwar, KTDH-19 and SARC-l. They observed that under salinity condition up to EC 19 dS m^{-1}, plant height, shoot dry weight and root length were decreased.

Singh *et al*. (2000) reported from a study that seeds of 20 wheat varieties were subjected to salinity stress during seedling growth along with the control. The salinity levels used were 0.0% (control) and 0.5% with corresponding EC values of 2.8 and 20.8 dS m^{-1} respectively. Seedling growth declined under salinity stress. The genotypes Raj-3077 and Kharchia-65 were tolerant to salinity with respect to seedling vigor while Raj4530 and Raj-3934 were most susceptible genotypes under salinity. Akram *et al.* (2002) studied in a pot experiment the effect of salinity (10, 15, 20 dS m^{-1}) on the yield and yield components of salt tolerant (234/2), medium responsive (243/1), and susceptible (Fsd 83) wheat varieties. They reported that salinity reduced the spike length, number of spikelets $spike^{-1}$, number of grains $spikelet^{-1}$, 1000-grains weight, and yield per plant of all the varieties but the susceptible variety was affected the most adversely. Noaman (2000) conducted a pot experiment with four durum wheat, (*Triticum turgidum l*ines .133. 146, 56 and 83) with kanal transferred from *Tritcum aestivum*cv. Sakha-8 (control), *Hordeum vulgarae* cv. Giza (control), *Triticum turgidum* cv. Langdon (LDN) and recombinant DS4D (LDN4B), which were grown at 3 levels of salinity (2, 4 and 8g $liter^{-1}$). He reported that increasing salinity affected plant height in most lines (24.5% reduction). Increasing salinity levels had no significant effect on the number of days from planting to booting, heading or flowering, even though differences among genotypes were significant. The DS4D (LDN 413) had the highest biological yield and grain yield under all salinity than the lines 133, 146 and 83 of 8 *Triticum turgidum* cv. Langdon (LDN) which showed the greatest sensitivity to salinity. Flagella *et al.* (2000) evaluated the effect of salinity on grain yield and yield components of durum wheat cv. Duilio subjected to the salinity levels of 0.5, 6, 12; 18 and 24 dS m^{-1} in a growth chamber. The changes in photosynthetic activity were 7 not related to changes in leaf turgor. With regard to photosynthesis and grain yield, durum wheat was moderately resistant to salinity showing significant damages only when irrigation water with EC of 12 dS m^{-1} or higher was used. Bouaounia *et al.* (2000) studied the salt tolerance of durum wheat (*Triticum turgidum*). They observed decreased growth of whole plants, delayed emergence of new leaves and limited K+ and Ca++ accumulation in these organs under NaCl treated soil salinity. Moreover, Na+ accumulation decreased from older to younger leaves. Cellular dry matter production was not much affected in spite of a drop in cellular water content. Depressive effects of K+ and Ca++ accumulation were evident while Na+ cellular accumulation increased with NaCl concentration. These results suggest that wheat has mechanisms to restrict Na+ transport and accumulation in younger leaves.

Gawish et al. (1999) studied the responses of status and translocation of Na, Cl, N and production for both shoots and roots of two wheat varieties differing in salt tolerance, Giza-164 as a relatively salt tolerant and Sakha-69 as a relatively salt sensitive variety to salinity. The plants were treated with NaCl, $CaCl_2$ or their mixture at a level of 50, 750, 1500 or 3000 ppm, after the 1st leaf had emerged. The status of Na and Cl positively responded in shoots. The rate of translocation for the different ions was higher under salinity conditions, particularly in relatively salt tolerant plants presumably due to osmotic adjustment as to reduce the adverse effect on root growth. Halim et al. (1988) conducted a pot experiment with Maxipak wheat growth in soil salinized by the addition of MgSo4: NaCl, $CaCl_2$ (5: 2: 3respectively). The salinity level of EC 1.7, 4.2, 5.8, 9.4 and 11.0 dS m^{-1} were used at 25, 50 and 75 percent level of available soil moisture depletion. They observed that soil water decreased the soil salinity increased, the dry matter per plant, plant height, tiller or spike number per 9 plant were decreased at all the growth stages. Grain yield, grain number and root dry matter decreased. Root growth showed the greatest sensitivity to soil salinity.

Islam and Salam (1996) The impact of salt stress under different salinity level (0, 25, 50, 75, 100, 125, 150 mM NaCl) on five varieties of Wheat viz., HOW-234, HD-2689, RAJ 4101, RAJ 4123, and HD 2045 was conducted. The data showed that different level of salinity significantly affected the growth attributes by reducing root and shoot length for salinity below 125mM. Fresh weight and dry weight of root and shoot were reduced significantly with subsequent treatment. Regarding germination maximum germination was found in variety HD2689 in all the treatments and maximum inhibition was found to be in case of HOW234 variety at 150mM salinity level. Regarding biochemical analysis the sugar, proline content increased with increasing salinity level where as protein content decreased in the physiologically active leaves of different treatments for all the varieties of wheat.

Mohammad *et al.* (1995) conducted an experiment with five wheat lines (PK-15869, PK-15885, PL-16171, PK-16172 and PK-16187) under saline condition. These lines were tested for salt tolerance in the presence of specific ions (Na^{+}, Ca^{2+}, Cl^{-}, and 10 $SO4^{2-}$). The seeds were germinated on agar medium containing varying salt concentrations (EC 0, 5, 10, 20, 25 and 30 dS m^{-1}). The genotypes PK-16171 showed the highest percentage germination shoot length, plant fresh weight and dry matter yield under different salinity levels. Fresh and dry weights of plants were reduced in the presence of salinity in majority of the trails. Two genotypes, PK-15885 and PK16171 showed salt tolerance.

Gupta and Shrivastava (1989) also observed in a sand culture trial that the effects of ionic osmotic stress alone and in combination with NaCl, tow wheat cultivars differed significantly. They observed Karicha-65(tolerant) was superior to Kalayansona (susceptible) in maintaining higher leaf area and root growth under both types of stress. They had the opinion the salinity stress was less injurious than osmotic ionic stress. Rahman *et al. (*1989) conducted an experiment in the glasshouse of BINA to screen out tolerant cultivars of wheat & barley. Results of the experiment indicated that all the crops, particularly wheat cultivars "Akbar" & "Kanchan," produced higher dry matter yield in varying degrees of salinity conditions created by mixing a saline soil of Shatkhira region. They reported that all these crops can be successfully grown in the salt affected areas of Bangladesh.

Barrett-lennard (1988) conducted a greenhouse experiment with wheat and observed that under moderately saline soil, 7days of water logging condition increased Na content by >200 percent in shoot. In a second experiment wheat was grown under either drained or water logged condition for 33 days with 0, 22 or 120 mM NaCl. A visual assessment showed that drained plants were healthy even with 120 mM NaCl.

2.5 Effect of salinity on growth and yield contributing parameters

In an experiment with four tomato cultivars, Sholi (2012), reported that growth parameters (such as fresh and dry weights) were reduced by the saline conditions. As the salt concentration was increased, plant growth was reduced. Naseer *et al.*, (2001) also reported that under salt stress fresh and dry weights (root and shoot) of barley cultivars decreased significantly. This was also recorded in wheat (Akbarimoghaddam et al., 2011). Salinity does not only affect vegetative development but also reproductive development. Most investigations indicate that with increased concentration of NaCl, both root and shoot lengths decreases. This was found in barley (Naseer *et al.,* 2001, Yousofinia *et al,.* 2012) and wheat (Rahman *et al.,* 2008, Akbarimoghaddam *et al.,* 2011).

In order to study the effect of salts stress on the growth and yield of wheat (cv. Inqalab), a pot experiment was conducted in the wire-house of the Department of Soil Science, Sindh Agriculture University Tando Jam. The soil was artificially salinized to a range of salinity levels i.e . EC 2.16, 4.0, 6.0, 8.0 and 10.0 dS·m−1 with different salts ($MgCl_2$ + $CaCl_2$ + Na_2SO_4). The salinized soil used for the experiment was sandy clay in texture, alkaline in reaction (pH > 7.0) and moderate in organic matter (0.95%) content. The results showed that with increasing salinity there was an increase in the ECe, Na+, Ca2+, Mg2+ and Cl− and decrease in the K+, SAR and ESP values of the soil Increasing salinity, progressively decreased plant height, spike length, number of spi- kelets spike^{-1}-1000 grain weight and yield (straw and grain). Adverse effects of salts on plants were associated with the accumulation of less K+ and more Na^+ and Cl^{-1} in their flag leaf sap, grains and straw. This resulted in lower K+:5Na+ ratio in flag leaf sap, grains and straw of wheat plants. These results indicated that the effects of salts stress were greater at 10 than at 8,6 and 4 EC dS m^{-1}. Growth is an irreversible increase in size or volume, while development is defined as changes during the life history of an organism, for example tissues form a specific pattern. Development is controlled by mechanisms such as genes, hormones, environment and cellular changes. Growth stages include embryogenesis, vegetative and reproductive development. Salinity affects both vegetative and reproductive development (Lauchli and Grattan, 2007)

Root/shoot length ratio was increased as compared to control under 5 and 15 dS m^{-1} NaCl salinity in both cultivars in present study. While at higher salinity (15 dS m^{-1}) root/shoot length ratio was similar to control in Pak-81 and was slightly higher than control in Lu-26. Recently in a study, thirty diverse genotypes of bread wheat were evaluated for root-to-shoot length ratio and osmotic membrane stability under laboratory conditions. The root-to-shoot length ratio, increased under osmotic stress. Correlation studies indicated that the osmotic membrane stability and root/shoot length ratio were the important traits, on the basis of their relationships with other traits (Dhanda *et al.,* 2004).

Husain *et al.*, (2003) used six durum wheat genotypes with varying sodium accumulation to assess the effect of Sodium exclusion on biomass production in saline soil. Plant height and dry biomass were measured at 3 salinity levels (1, 75 and 150mM NaCl). At ear emergence, the effects of salinity on biomass were less on low Na+ than on the high Na+. At maturity, salinity had a similar effect on biomass of both genotypes at both 75 and 150 mM NaCl. In the present study, at seedling stage the root dry weight was higher in salt tolerant cultivar as compared to control under low (5 dSm-1) and medium (10 dS m^{-1}) salt stress.

Crops growing in salt-affected soils may suffer from physiological drought stress, ion toxicity, and mineral deficiency. A pot study was conducted in 2004-2005 in the Aghala area (northern Iran) to study the effect of different salinity levels, i.e. ECe= 3 (control), 8, 12 and 16 dS m^{-1} on wheat grain, yield components and leaf ion uptake of four Iranian wheat genotypes, i.e. Kouhdasht, Atrak, Rasoul and Tajan. Treatments were replicated three times in a completely randomized design in a factorial arrangement. Desired salinity levels were obtained by mixing adequate NaCl before filling the pots. Soil water was maintained at 70% of available water holding capacity.

Results revealed that Kouhdasht and Tajan showed highest and lowest grain yield and its components as compared to other cultivars at different salinity levels. Leaf Na+ and Cl- concentrations of all genotypes increased significantly with increasing soil salinity, with the highest concentrations in Tajan, followed by Rasoul, Atrak and Kouhdasht cultivars, respectively. Highest leaf K+ concentration and K+: Na+ ratio were observed in Kouhdasht cultivar, followed by Atrak, Rasoul and Tajan, respectively. Therefore, Kouhdasht and Atrak were identified as the most salt-tolerant genotypes as compared to two other wheat genotypes (Asgari *et al.*, 2001).

Del Zoopo *et al.* (1999) studied the effect of 50 to 200 mM NaCl on two lines (CP with solid stem and CV with hollow stem) of Haynaldoticumsardoum. NaCl significantly reduced shoot length of CP and CV plants. In the present study, shoot length was also decreased in both cultivars with increasing level of salinity.

According to Khatun et al. (1995), salinity delayed flowering, reduced the number of productive tillers, the number of fertile florets per panicle, the weight per grain and grain yield of rice.

MATERIALS AND METHODS

A field experiment entitled "Effects of priming and salt stress on growth, yield and nutrient uptake of wheat genotypes" was carried out under field conditions during November 2017 to June 2018, .at the Agronomy field of Sher-e-Bangla Agricultural University, Dhaka -1207. Details of the research work carried out, materials used and methodologies adopted in this research are described here under.

3.1 Experimental site

The farm is geographically located at $23^0 77'$ N latitude and $90^0 35'$ E longitude at an altitude of 8.6 m above mean sea level under the Agro-ecological zone of Modhupur Tract, AEZ-28 (Appendix I).

3.1.1 Weather during the crop growth period

The climate of the experimental site is subtropical. It receives rainfall mainly from South West monsoon (May-October) and winter season from November to February. The weather data during experimental period was collected from the Meteorological Station of Sher-e Bangla Nagar Dhaka-1207, presented in Appendix II.

The maximum temperature during the crop growth period ranged from 15^0C to 35^0 C with an average of 28.5^0 C during 2018, while the minimum temperature 10^0 C to 24^0 C with an average 17.33^0 C. The mean relative humidity ranged from 57 percent to 74 percent. The total rainfall received during the crop growth period was 302 mm in 27 rainy days.

3.1.2 Soil

The soil of the research field belongs to "The Modhupur Tract", AEZ – 28 is slightly acidic in reaction with low organic matter content. The experimental area was above flood level and sufficient sunshine with having available irrigation and drainage system during the experimental period. Soil sample from 0-15 cm depth were collected from experimental field and the soil and plant analysis were done from Soil Resources Development Institute (SRDI), Dhaka. The experimental plot was high land having pH 5.6. The physical properties and nutritional status of soil and plant of the experimental plot are given in Appendix III.

3.2 Test crops

Three wheat genotypes namely- BARI Gom 28, ESWYT 5 and ESWYT 6 were used for this experiment, seeds were collected from Wheat Research Centre, Dinajpur and Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh. The collected wheat genotypes were free from any visible defects, disease symptoms and insect infestation.

3.3 Experimental details

3.3.1 Treatments:

Three sets of treatments included in the experiment were as follows:

Factor A: Varieties: 3

i. V_0= ESWYT 5
ii. V_1= ESWYT 6
iii. V_3= BARI Gom 28

Factor B: Priming agent

i. P_0= Control(without priming)
ii. P_1= 5% Polyethylene Glycol (PEG)
iii. P_2= 2%Mannitol

Factor C: Salt stress

i. S_0= Control(No salt)
ii. S_1= 10dS$^-$1
iii. S_2= 15dS$^-$1

3.3.2 Experimental design

The experiment was laid out in a split-split plot design with three replications having 27 treatment combinations. The total numbers of unit plots were 81.

3.4 Priming agent

5% PEG and 2% Mannitol was used as priming agent. Five gram of mannitol was dissolved in 250 ml of water to prepare 2% mannitol solution. Five gram of PEG was dissolved in 100 ml of water to prepare 5% solution of PEG.

3.5 Preparation of salt stress solutions with NaCl

NaCl was used for inducing salt stress. 1.436 g and 2.18 g of sodium chloride (Nacl) was dissolved in 250 ml of distilled water for preparing 10 dS m^{-1} and 15 dS m^{-1}, solution of NaCl, respectively.

3.6 Land preparation

The land of the experimental field was first opened on November 5, 2017 with a power tiller. Then it was exposed to the sunshine for 7 days prior to the next ploughing. Thereafter, the land was ploughed and cross-ploughed to obtain good tilth. Deep ploughing was done to produce an optimum tilth, which was necessary to get better yield of the crop. Laddering was done in order to break the soil clods into small pieces followed by each ploughing. All the weeds and stubbles were removed from the experimental field. The soil was treated with insecticides at the time of final ploughing. Insecticides Furadan 5G was used @8 kg ha-1 to protect young plants from the attack of mole cricket, ants, and cutworms. The experimental field was then divided into unit plots and prepared before seed sowing.

3.7 Fertilizer application

All the fertilizers were applied at the rate of BARI recommended dose as 150kg ha TSP, 50 kg ha MOP, 120 kg ha Gypsum. Nitrogen fertilizers were applied as per treatments in each plot. Fertilizers other than nitrogen were given during land preparation. The whole amount of all the fertilizers except urea were applied at the time of land preparation and thoroughly incorporated with soil with the help of a spade.

3.8 Seed treatment

Seeds were treated with Vitavex-200 @ 0.25% before sowing to prevent seeds from the attack of soil borne disease. Furadan @1.2 kg ha^{-1} was also used in soil to protect seed against wireworm and mole cricket.

3.9 Seed sowing

Seeds were sown on November 14, 2017 continuously in 20 cm apart rows opened by specially made iron hand tine. The seed rate was 120 kg ha^{-1}. After sowing, the seeds were covered with soil and slightly pressed by hands.

- Seed priming.
- Development of salinity labels in soil.

3.10 Intercultural operations

The following intercultural operations were done for ensuring the normal growth of the crop.

3.10.1 Thinning

Emergence of seedling was completed within 10 days after sowing. Overcrowded seedlings were thinned out for two times. First thinning was done after 15 days of sowing which is done to remove unhealthy and lineless seedlings. The second thinning was done 15 days after first thinning keeping one or two or three healthy seedlings in each hill according to the treatment.

3.10.2 Weeding

Weeding was done as per the experiment treatment.

3.10.3 Irrigation and drainage

The experimental plots required two irrigations during the crop growth season and sometimes drainages were done at the time of heavy irrigation. The first irrigation was done at 20 DAS, crown root initiation stage. Second irrigation was provided at 50 DAS which is the maximum tillering stage of wheat and the last irrigation was done a 72 DAS, grain filling stage. Proper drainage system was also made for draining out excess water.

3.10.4 Plant protection measures

There were negligible infestations of insect-pests during the crop growth period. The experimental crop was not infected with any disease and no fungicide was used. Mole cricket and cutworm attacked the crop during the early growing stages of seedlings. Spraying Diazinon 60EC controlled these insects was done at optimum doses. The insecticide was sprayed three times at seven days interval.

3.10.5 General observations of the experimental field

Regular observations were carried out to see the growth stages of the crop. In general, the field looked nice with normal green plants which were vigorous and luxuriant in the treatment plots than that of control plots.

3.11 Harvest and post-harvest operation

The maturity of crop was determined when 85% to 90% of the grains become golden yellow in color. Harvesting of all three varieties were done 1st and 2nd march, 2018 as those varieties are almost synchronize with their maturity. From the centre of each plot 1 m^2 was harvested to assess yield of individual treatment and converted into ton ha^{-1}. The harvested crop of each plot was bundled separately, tagged properly and brought to threshing floor. The bundles were dried in open sunshine, threshed and then grains were cleaned properly. The grain and straw weights for each experimental plot were recorded after proper drying in sun. Before harvesting, ten hills were selected randomly outside the sample area of each plot and cut at the ground level for collecting data on yield contributing characters.

3.12 Data collection

A. Plant and Yield contributing characters:

a. Plant height

b. Number of effective tillers $hill^{-1}$

c. Number of spikes $hill^{-1}$

d. Spike length (cm)

e. Filled grains spike^{-1} (no)

f. Weight of 1000 grains (gm)

g. Total grain spike^{-1}(no)

B. Yield and Harvest index:

a. Grain yield plant^{-1}

b. Straw yield plant^{-1}

c. Harvest index (%)

C. Plant sample analysis

a. Nitrogen (N) %

b. Potassium (K) %

c. Calcium (Ca) %

D. Soil Sample Analysis

a. pH

b. Nitrogen (N) %

c. Potassium (K) ppm

d. Calcium (Ca) ppm

e. Organic Carbon (OC)%

f. Phosphorus (P) ppm

g. Iron (Fe) ppm

3.13 Procedure of data collection

3.13.1 Plant height (cm)

Plant height was recorded for the ten randomly tagged hills in each treatment in all the three replications. Plant height was measured from the base of the plant to tip of the top leaf of every labeled hill at harvest. The plant height is expressed in centimeters (cm).

3.13.2 Number of effective tiller hill^{-1}

The spike which had at least one grain from the ten labeled plants at harvest were counted as effective tillers hill^{-1}.

3.13.3 Number of spike hill^{-1}.

Randomly, ten hills were selected for counting spike and the average expressed as spike hill^{-1}.

3.13.4 Spike length (cm)

Measurement of spike length was taken from base to apex of each spike. Each observation was an average total spike of ten hills and expressed as centimeters.

3.13.5 Filled grain spike^{-1} (no.)

Grain was considered to be filled if any kernel was present there in. The number of total filled grains present total spike of ten hill were recorded and finally averaged.

3.13.6 Weight of 1000 grains (gm)

One thousand grains were counted from a random sample for each treatment from a composite sample drawn from the net plot yield, weighed and expressed as 1000 seed weight (g).

3.13.7 Total grain spike^{-1} (no.)

The number of total filled grains plus empty grains present total spike of ten hill were recorded and finally averaged.

3.13.8 Grain yield (t ha^{-1})

The crop harvested from 1m^2 each treatment was bundled separately and sun dried and later threshed individually plot-wise by manual labour. Cleaning of the grain was done after threshing followed by sun drying to a constant weight to record the final yield.

3.13.9 Straw yield plant^{-1} (t ha^{-1})

Straw from 1m^2 each of each plot was dried in sun to a constant weight. Straw yield finally express as t ha^{-1}.

3.13.10 Harvest index (%).

Harvest index is the ratio of grain yield to the total biological yield (grain + straw) and expressed in percent. It was calculated using the formula given hereunder assuggested by Yoshida (1981).

$$\text{HI (\%)} = \frac{Grain\ yield}{Biological\ yield} x\ 100$$

3.14 Plant sample analysis

From each plot ten plant were collected for analysis Nitrogen (N)%, Potassium(K)% and Calsium(Ca)%. The samples were analyzed in Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur.

3.15 Soil Sample Analysis

From each plot 500g soil was collected immediately after harvest for soil nutrient analysis *viz.* pH, nitrogen (N) %, potassium (K) ppm, calcium (Ca) ppm, organic carbon (OC)%, phosphorus (P) ppm, iron (Fe) ppm and and water retention capacity (WRC). The analysis of soil nutrient was done in Soil Resource Development Institute (SRDI), Farmgate, Dhaka.

3.16 Statistical analysis

All the data recorded are subjected to statistical analysis using computer software program statistics 10. Standard error at 0.05 levels was worked out for the effects, which were significant. The results were presented in tables and depicted graphically wherever necessary.

RESULTS AND DISCUSSION

An experiment was conducted at field of Department of Agronomy, Sher-e-Bangla Agricultural University (SAU), Sher-e-Bangla Nagar, Dhaka-1207 during the period from November 2017 to June 2018 to study the "Effects of priming and salt stress on growth, yield and nutrient uptake of wheat genotypes". The results of the experiment analyzed statistically are discussed in this chapter with cause, effects and corroborative research findings of the scientists.

4.1 Plant height

4.1.1 Effect of variety

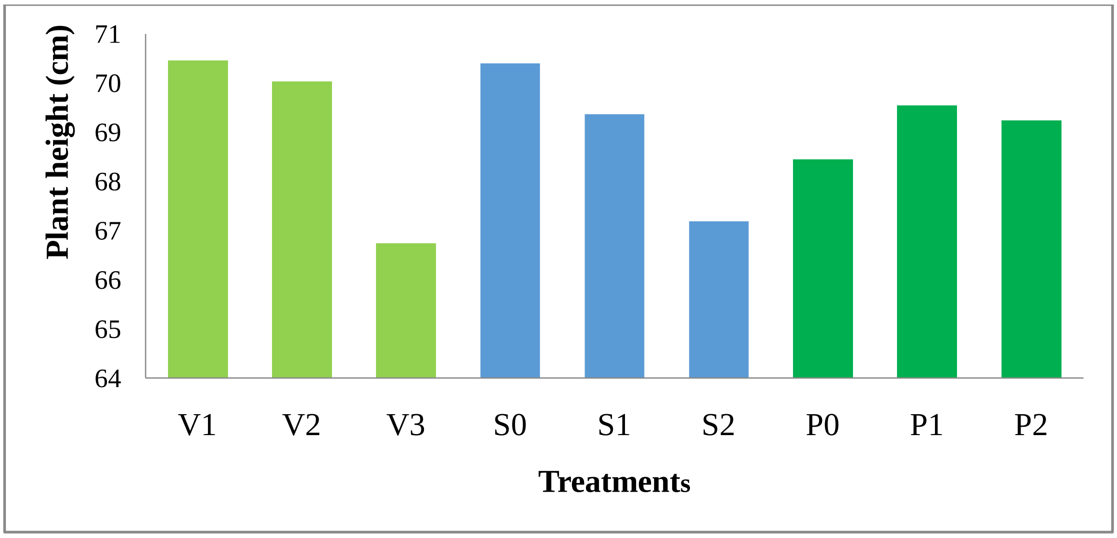
The data pertaining to plant height of wheat at harvest presented in Fig. 1. ESWYT 5 (V1) significantly showed tallest plant which was statistically similar with ESWYT 6 (V_2). The shortest plant was found in BARI Gom 28 (V_3). The difference in plant height of varieties might be due to difference in their genetic makeup. Difference in plant height with different varieties was also observed by Priyadarsini (2001).

4.1.2Effect of salt stress

Plant height of wheat at harvest as influenced by different salinity levels are presented in Fig. 1. It is noticed that plant height was significant with salt stress. The longest plant (70.46 cm) was obtained from no salt (S_0) followed by 10 dS m^{-1} (S_1). The shortest spike was found in15 dS m^{-1} (S_2).

4.1.3 Effect of priming agent

Plant height of wheat exerted non-significant variation due to priming agent (Fig. 1) but tallest (69.54 cm) plant was observed from P_1 (5% PEG) and the lowest (68.44) at without priming (P_0). The result was in line with that of Khan (1992) who also found similar effect regarding the effect of seed priming on plant height.



V_0 = ESWYT 5, V_1 = ESWYT 6, V_3 = BARI Gom 28; P_0 = Control (without priming), P_1 = 5 %PEG, P_2 = 2% Mannitol; S_0 = Control (No salt), S_1 = 10 dS m^{-1}, S_2 = 15 dS m^{-1}

Figure 1. Effect of variety, salt stress and priming treatment on plant height of wheat

4.1.4 Interaction effect of variety and salt stress

Plant height was significantly influenced by the interaction effect of varieties and salt stresses are manifested in Table 1. The tallest plant (72.55 cm) was recorded in interaction of V_1S_0 which was statistically similar with all combination except V_3S_2. On the other hand, the shortest plant (64.85 cm) was obtained from V_3S_2 which was statistically similar with V_1S_2, V_2S_0, V_2S_2, and V_3S_1.

Table 1. Interaction effect of variety and salt stress on yield attributes of wheat

Treatment	Plant height (cm)	Effective tillers $hill^{-1}$	Spike $hill^{-1}$ (no.)	Spike length (cm)	Filled grains $spike^{-1}$(no.)	Total grains $spike^{-1}$ (no.)
V_1S_0	72.55 a	11.43 a	6.60 a	9.73 a	31.39 a	34.12 a
V_1S_1	71.61 a	8.96 b	6.03 a	9.06 a	24.32 c	29.62 b
V_1S_2	69.19 ab	7.46 c	3.94 de	7.30 b-d	23.13 c	27.90 b
V_2S_0	70.02 ab	9.95 b	5.85 ab	7.83 b	29.08 ab	34.91 a
V_2S_1	70.58 a	9.01 b	5.07 bc	6.83 b-d	23.26 c	28.64 b
V_2S_2	67.52 ab	7.74 c	4.04 de	7.46 b-d	11.15 d	17.45 c
V_3S_0	67.51 ab	9.45 b	5.12 bc	7.66 bc	23.3 c	34.41 a
V_3S_1	67.86 ab	7.75 c	4.61 cd	6.50 d	27.80 b	28.68 b
V_3S_2	64.85 b	7.42 c	3.33 e	6.66 cd	12.15 d	16.36 c
CV (%)	**5**	**8.74**	**12.09**	**8.76**	**8.23**	**6.77**
LSD $_{(0.05)}$	**5.2650**	**1.1737**	**0.9139**	**1.0257**	**2.8699**	**2.8906**

V_1S_0 = ESWYT 5 × S_0 = Control (No salt); V_1S_1 = ESWYT 5 × 10dS m^{-1} ; V_1S_2 = ESWYT 5 × 15 dS m^{-1} ; V_2S_0 = ESWYT 6 × S_0 = Control (No salt); V_2S_1 = ESWYT 6 × 10 dS m^{-1} ; V_2S_2 = ESWYT 6 × 15 dS m^{-1}; V_3S_0 = BARI Gom 28 × S_0 = Control (No salt); V_3S_1 = BARI Gom 28 × 10 dS m^{-1} and V_3S_2 = BARI Gom 28 × 15 dS m^{-1} .

4.1.5 Interaction effect of variety and priming agent

Plant height of wheat differed significantly due to interaction effect of varieties and priming agent (Table 2). The highest plant (71.65 cm) was recorded with the interaction of $V_1P_{1,}$ whereas, the shortest plant (65.93 cm) was recorded with V_3P_0 which was significantly different from all other treatment combinations except $V_3P_{1.}$

4.1.6 Interaction effect of salt stress and priming agent

Plant height of wheat differed significantly due to interaction effect of salt stress and priming agent (Table 3). The highest plant (72.31 cm) was recorded with the interaction of S_0P_1 which was significantly similar with all other treatment combinations except S_1P_0 and S_2P_0. The shortest plant (66.78 cm) was recorded with $S_2P_{0.}$

4.1.7 Interaction effect of variety, salt stress and priming treatment

Plant height was not significantly influenced by the interaction effect of variety, salt stress and priming treatment. The results are manifested in Table 4. Numerically the tallest plant (75.67cm) was recorded in interaction of $V_1S_0P_1$ and the shortest plant (64.84cm) was obtained from $V_3S_2P_{0.}$

4.2 Effective tillers hill^{-1}

4.2.1 Effect of variety

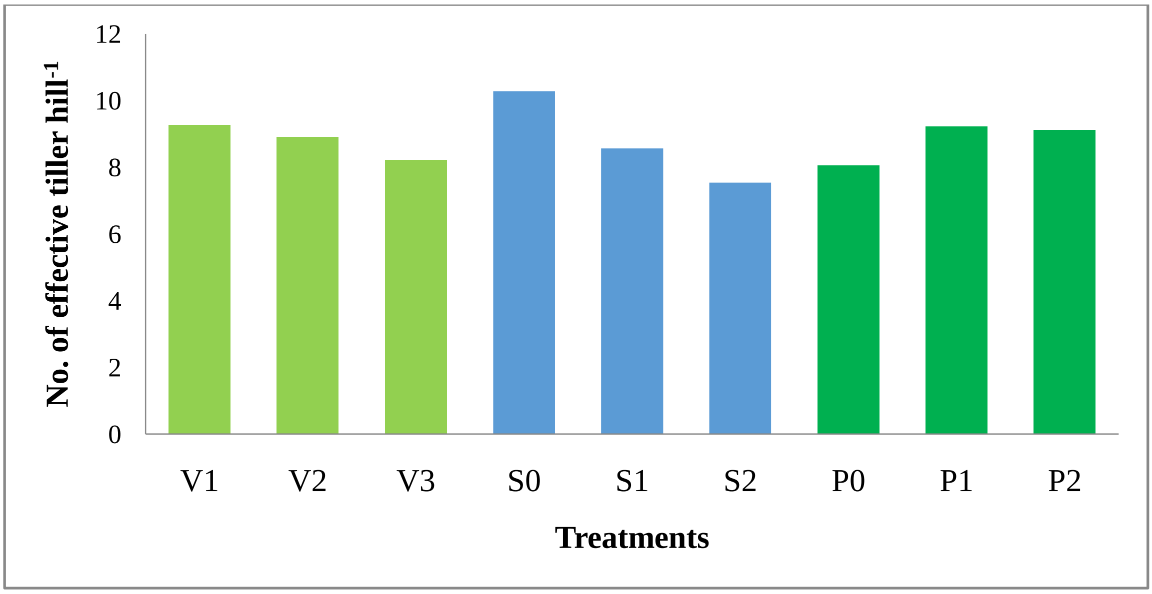
The data regarding the effective tillers hill^{-1}of wheat at harvest (Figure 2) indicated that significant influence by different varieties. ESWYT 5 (V_1) significantly showed effective tillers hill^{-1} (9.27) which was statistically similar with ESWYT 6 (V_2). The shortest plant was found in (V_3) BARIGom 28 (V_3).

4.2.2 Effect of salt stress

Effective tillers hill^{-1} of wheat differed significantly due to different salt stress on wheat (Fig. 2). The maximum effective tillers hill^{-1}(10.28) was obtained from no salt (S_0) and the lowest (7.54) was observed in15 dS m^{-1} (S_2)**.**

4.2.3 Effect of priming agent

The influence of priming agent on effective tillers hill^{-1} of wheat showed significant variation (Fig. 2). The results indicated that the different priming agent significantly increased effective tillers hill^{-1} as compared to no priming (P_0). The highest effective tillers hill^{-1} (9.22) was recorded from P_1 (5 % PEG) which was statistically similar with 5% PEG (P_2). The lowest (8.06) was obtained from without priming (P_0). The result was similar with that of Ghassemi-Golezani *et al*. (2008).



V_0 = ESWYT 5, V_1 = ESWYT 6, V_3 = BARI Gom 28; P_0 = Control (without priming), P_1 = 5 % PEG, P_2 = 2% Mannitol; S_0 = Control (No salt), S_1 = 10 dS m^{-1}, S_2 = 15 dS m^{-1}

Figure 2. Effect of variety, salt stress and priming treatment on effective tillersof wheat

4.2.4 Interaction effect of variety and salt stress

Interaction between varieties and salt stress was observed significantly positive effect on number of effective tillers hill^{-1} (Table 1). The maximum effective tillers hill^{-1} (11.43) was observed in interaction treatment of V_1S_0 compared to others interactions. The lowest effective tillers hill^{-1} (7.42) was noticed in interaction of V_3S_2.

4.2.5 Interaction effect of variety and priming agent

Interaction effect of varieties and priming treatment was significantly influence on effective tillers hill^{-1} (Table 2). Results indicated that the highest effective tillers hill^{-1} (9.86) was with interaction of V_1P_1 which was statistically similar with all other treatment combinations except V_3P_0 as it had given the lowest number of effective tillers hill^{-1}.

Table 2. Interaction effect of variety and priming agent on yield attributes of Wheat

Treatment	Plant height (cm)	Effective tillers hill^{-1}	Spike hill^{-1}	Spike length (cm)	Filled grains spike^{-1} (no.)	Total grains spike^{-1} (no.)
V_1P_0	67.52 ab	8.33 bc	4.70 bc	6.83 d	22.69 b	27.71 b
V_1P_1	71.65 a	9.86 a	6.31 a	9.73 a	26.93 a	32.45 a
V_1P_2	70.27 ab	8.95 ab	5.00 bc	8.03 bc	24.14 ab	28.50 b
V_2P_0	66.77 ab	8.30 bc	4.33 cd	6.83 d	19.08 c	24.25 c
V_2P_1	70.69 ab	9.66 a	5.57 ab	8.33 b	24.64 ab	30.34 ab
V_2P_2	69.46 ab	8.85 ab	4.94 bc	7.50 b-d	22.78 b	28.19 b
V_3P_0	65.93 b	7.48 c	3.52 d	6.50 d	18.08 c	23.70 c
V_3P_1	70.36 ab	9.35 ab	5.31 b	8.20 b	24.60 ab	28.80 b
V_3P_2	69.04 ab	8.40 bc	4.91 bc	7.10 c	22.71 b	28.14 b
CV (%)	**5**	**7.54**	**10.03**	**7.76**	**9.23**	**9.77**
LSD $_{(0.05)}$	**1.1737**	**0.9139**	**1.0257**	**1.0257**	**2.8699**	**2.8906**

V_1P_0 = ESWYT 5 × Control (no priming); V_1P_1 = ESWYT 5 × 5% PEG; V_1P_2 = ESWYT 5 × 2% Mannitol; V_2P_0 = ESWYT 6 × Control (no priming); V_2P_1 = ESWYT 6 × 5% PEG; V_2P_2 = ESWYT 6 × 2% Mannitol; V_3P_0 = BARI Gom 28 × Control (no priming); V_3P_1 = BARI Gom 28 × 5% PEG and V_3P_2 = BARI Gom 28 × 2% Mannitol.

4.2.6 Interaction effect of salt stress and priming agent

Interaction effect of salt stress and priming agent was significantly influence on effective tillers hill^{-1} (Table 3). Results indicated that the highest effective tillers hill^{-1}(10.77) was with interaction of S_0P_1. On the other hand, the lowest number of effective tillers hill^{-1} (6.71) was obtained from S_2P_0. S_0P_1 was statistically similar with all other treatment combinations except S_2P_0.

4.2.7 Interaction effect of variety, salt stress and priming treatment

Interaction between variety, salt stress and priming treatment was observed significantly positive effect on number of effective tillers hill^{-1} (Table 4). The maximum effective tillers hill^{-1} (11.65) was observed in interaction treatment of $V_1S_0P_1$ compared to others interactions. The lowest effective tillers hill^{-1} (6.33) was noticed in interaction of $V_3S_2P_0$.

4.3 Spike hill^{-1}

4.3.1 Effect of variety

The number of Spike Hill^{-1}was significantly influenced due to different varieties (Fig. 3). Result revealed that the maximum Spike Hill^{-1}(5.53) was observed in ESWYT 5

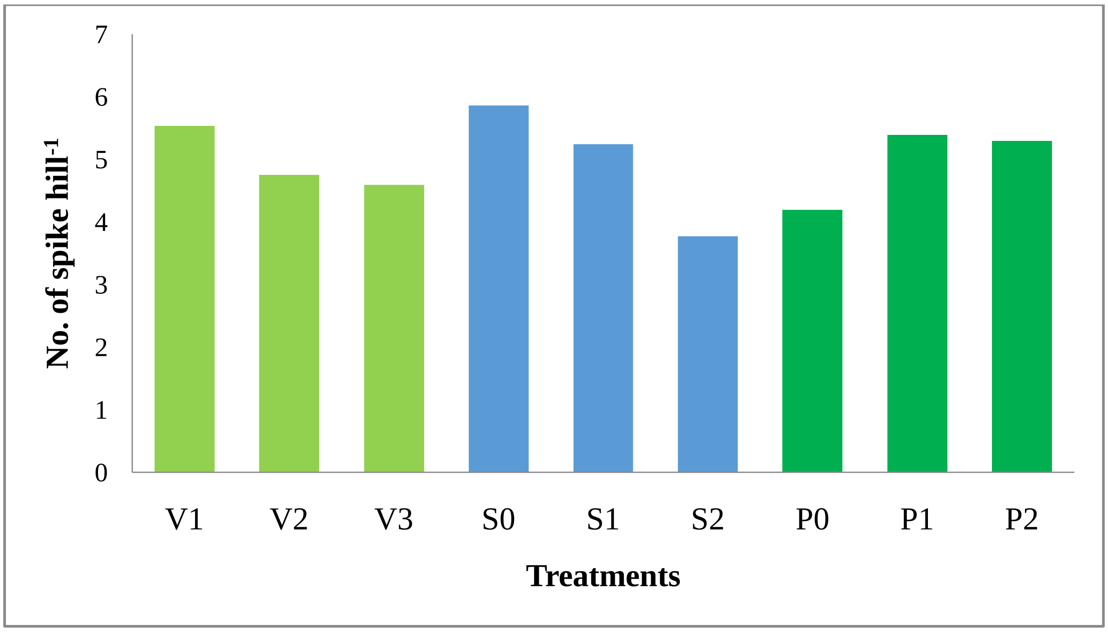
(V_1) and lowest Spike Hill^{-1}(4.49) was obtained from BARI Gom 28 (V_3) which was statistically similar with ESWYT 6 (V_2).

4.3.2 Effect of salt stress

The data the spike hill^{-1}of wheat as affected by different salt stress are presented in Fig. 3. Result noticed that the spike hill^{-1}decreased significantly by salinity increase. The maximum number of spike hill^{-1}(5.86) was observed in no salt (S_0) and the lowest one (3.77) at 15 dS m^{-1} (S_2).

4.3.3 Effect of priming agent

Spike hill^{-1} of wheat differed significantly due to different priming treatment (Fig. 3). The highest spike hill^{-1} (5.39) was recorded with P_1 (5 % PEG) which was statistically similar with 2% Mannitol (P_2). The lowest (4.19) was obtained from no priming (P_0). The result was in similar argument with Laghari *et al.* (2016) who also recorded an increase in seed germination rate and growth and yield attributes in consequent.



V_0 = ESWYT 5, V_1 = ESWYT 6, V_3 = BARI Gom 28; P_0 = Control (without priming), P_1 = 5 % PEG, P_2 = 2% Mannitol; S_0 = Control (No salt), S_1 = 10 dS m^{-1}, S_2 = 15 dS m^{-1}

Figure 3. Effect of variety, salt stress and priming treatment on spike number of wheat

4.3.4 Interaction effect of variety and salt stress

Interaction between variety and salt stress was affected significantly on spike hill^{-1} (Table 1). The highest spike hill^{-1} (6.60) was obtained from the interaction treatment of V_1S_0 followed by V_1S_1. The lowest spike hill^{-1} (3.33) was recorded in interaction of V_3S_2 which was statistically similar with V_1S_2 and V_2S_2.

4.3.5 Interaction effect of variety and priming agent

Interaction of varieties and priming treatment had a significant influenced on the spike hill^{-1} of wheat (Table 2). It was observed that V_1P_1 treatment interaction produced the highest spike hill^{-1} (6.31) of wheat which was statistically similar with V_2P_1 interaction. However, the lowest spike hill^{-1} (3.52) was recorded in V_3P_0 which was statistically similar with $V_2P_{0.}$

4.3.6 Interaction effect of salt stress and priming agent

Interactions of salt stress and priming agent had a significant influenced on the spike hill^{-1} of wheat (Table 3) The maximum spike hill^{-1} (6.81) was obtained from S_0P_1 which was statistically differed from all other combinations except S_1P_1. However, the lowest spike hill^{-1} (3.23) was recorded in S_2P_0 which was statistically similar with $S_1P_{0.}$

Table 3. Interaction effect of salt stress and priming agent on yield attributes of Wheat

Treatment	Plant height (cm)	Effective tillers hill^{-1}	Spike hill^{-1}	Spike length (cm)	Filled grains spike^{-1} (no.)	Total grains spike^{-1} (no.)
S_0P_0	67.36 ab	8.05 c	4.20 d	7.06 c	16.26 e	21.86 d
S_0P_1	72.31 a	10.77 a	6.81 a	9.03 a	30.28 a	35.55 a
S_0P_2	69.37 ab	8.84 bc	5.47 bc	7.50 bc	27.24 bc	32.30 b
S_1P_0	66.96 b	7.86 cd	3.88 de	7.00 c	15.41e	20.45 d
S_1P_1	71.38 ab	10.63 a	6.05 ab	9.03 a	29.19 ab	33.02 ab
S_1P_2	68.52 ab	8.83 bc	4.71 cd	7.36 bc	24.3 c	29.40 c
S_2P_0	66.78 b	6.71 d	3.23 e	6.53 c	14.75 e	19.40 d
S_2P_1	71.19 ab	9.42 b	5.63 b	8.36 ab	27.32 b	32.76 ab
S_2P_2	67.83 ab	8.05 c	4.62 cd	7.16 c	20.82 d	27.35 c
CV (%)	**7.6**	**9.89**	**12.78**	**13.34**	**12.67**	**7.77**
LSD $_{(0.05)}$	**1.1737**	**0.9139**	**1.0257**	**1.0257**	**2.8699**	**2.8906**

S_0P_0 = Control (no salt) × Control (no priming); S_0P_1 = Control (no salt) × 5% PEG; S_0P_2 = Control (no salt) × 2% Mannitol; S_1P_0 = 10 dS m^{-1} × Control (no priming); S_1P_1 = 10 dS m^{-1} × 5% PEG; S_1P_2 = 10 dS m^{-1} × 2% Mannitol; S_2P_0 = 15 dS m^{-1} × Control (no priming); S_2P_1 = 15 dS m^{-1} × 5% PEG; S_2P_2 = 15 dS m^{-1} × 2% Mannitol

4.3.7 Interaction effect of variety, salt stress and priming treatment

Interaction between variety, salt stress and priming treatment was affected significantly spike hill^{-1} (Table 4). The highest spike hill^{-1} (8.00) was obtained from the interaction treatment of $V_1S_0P_1$ whereas the lowest spike hill^{-1} (2.71) was recorded in interaction of $V_3S_2P_{0.}$

4.4 Spike length (cm)

4.4.1 Effect of variety

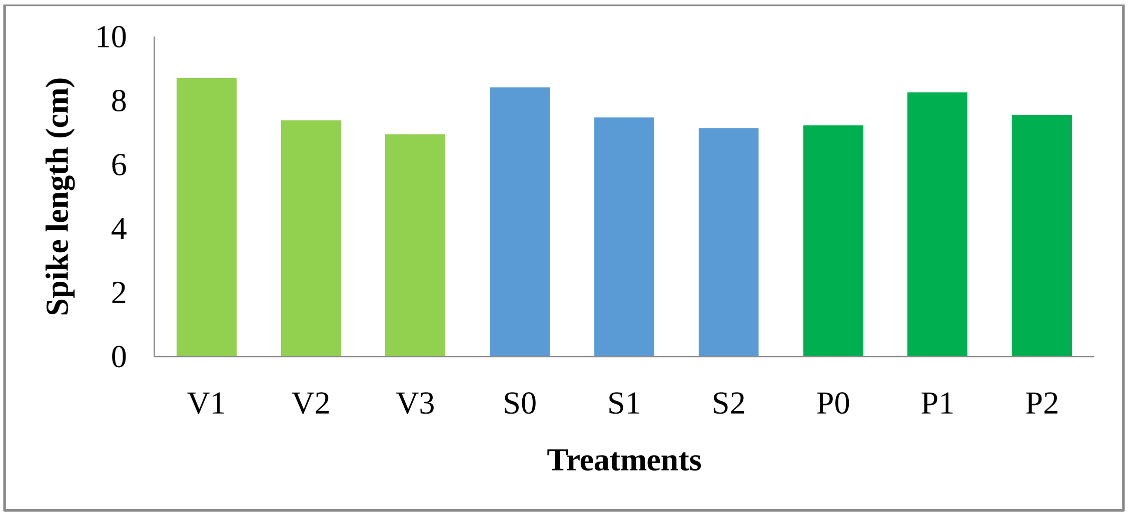
Spike length was significantly affected by wheat varieties (Fig. 4). The longest Spike (8.70 cm) was obtained from ESWYT 5 (V_1). The shortest spike was found in BARI Gom 28 (V_3) followed by ESWYT 6 (V_2). This may due to the genetic makeup of varieties that panicle length varies with variety to variety.

4.4.2 Effect of salt stress

Significant differences were noticed in respect of spike length in wheat due to salt stress (Fig. 4). Among the treatment of salt stress, the tallest spike (8.41 cm) was recorded in no salt (S_0). The shortest spike obtained from 15 dS m^{-1} (S_2) which was statistically similar with 10 dS m^{-1} (S_1).

4.4.3 Effect of priming agent

Application of priming treatment exerted significant affect on spike length of wheat (Fig. 4). The tallest spike (8.25 cm) was measured with P_1 (5 % PEG) treatment. The shortest spike (7.22 cm) was measured from without priming (P_0) which was statistically similar with P_2 (2% Mannitol). The finding was in agreement with Kumar *et al.* (2017).



V_0 = ESWYT 5, V_1 = ESWYT 6, V_3 = BARI Gom 28; P_0 = Control (without priming), P_1 = 5 % PEG, P_2 = 2% Mannitol; S_0 = Control (No salt), S_1 = 10dS^{-1}, S_2 = 15dS^{-1}

Figure 4. Effect of variety, salt stress and priming treatment on spike length of wheat

4.4.4 Interaction effect of variety and salt stress

Data on spike length are shown in Table 1, which was significantly influenced by interaction effect of varieties and salt stress treatment. Results showed that the highest spike length (9.73 cm) was observed in V_1S_0 which was significantly identical with

V_1S_1. The lowest number of spike length (6.50 cm) was obtained from V_3S_1 which was statistically similar with a number of treatment combinations.

4.4.5 Interaction effect of variety and priming agent

Spike length was influenced significantly due to interaction effect of varieties and priming treatment (Table 2). The maximum spike length (9.73 cm) was obtained from V_1P_1 which was statistically differed from all other combinations. The lowest spike length (6.50 cm) was recorded in $V_3P_{0.}$

4.4.6 Interaction effect of salt stress and priming agent

Spike length was influenced significantly due to interaction effect of salt stress and priming agent (Table 3). It was observed that S_0P_1 (9.03 cm) treatment interaction produced the longest spike of wheat which was statistically similar with S_1P_1 and S_2P_1. The lowest spike (6.53 cm) was recorded in S_2P_0 which was statistically similar with a number of treatment combinations.

4.4.7 Interaction effect of variety, salt stress and priming treatment

Data on spike length are shown in Table 4. From the experiment it was found that spike length (cm) was significantly influenced by interaction effect of variety, salt stress and priming treatment. Results revealed that the highest spike length (11.60 cm) was observed in $V_1S_0P_1$ and the lowest spike length (5.50 cm) was obtained from $V_3S_2P_{0.}$

4.5 Filled grains spike^{-1}

4.5.1 Effect of variety

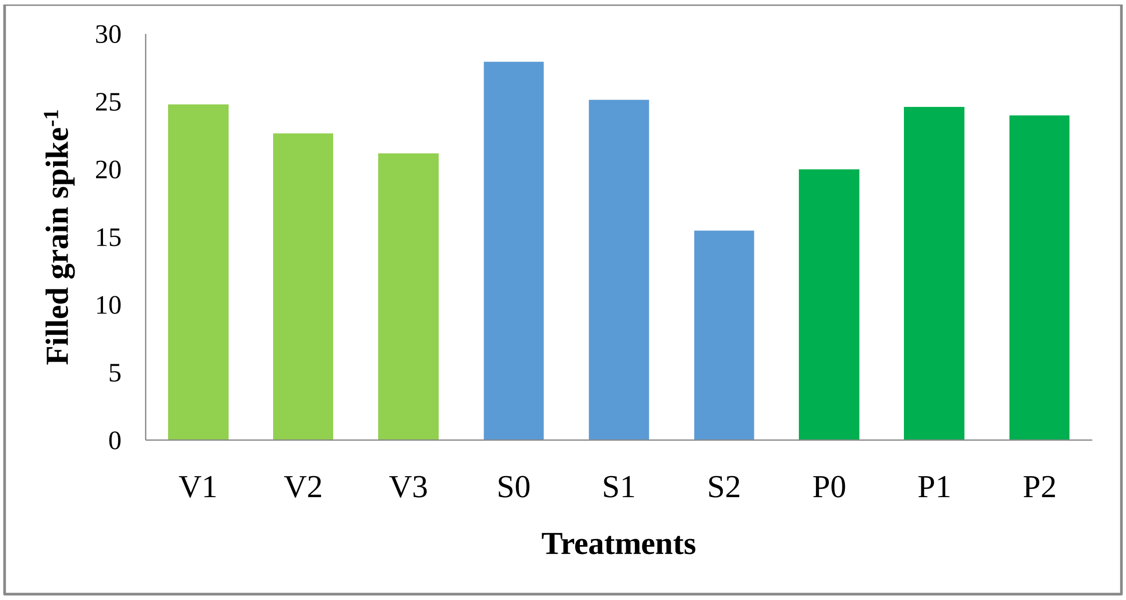
Number of filled grain spike^{-1} differed significantly due to varieties (Fig. 5). Significantly highest number of filled grains spike^{-1} (24.77) was recorded in ESWYT 5 (V_1). The lowest filled grain spike^{-1} (21.16) was obtained from BARI Gom 28 (V_3). Variation in grains panicle^{-1} might be due to difference in spike size of the varieties, which is a genetic character and specific to each variety.

4.5.2 Effect of salt stress

Filled grains spike^{-1} was affected significantly due to salt stress in wheat (Fig. 5) Indicating that increasing the salinity level decreased the number of filled grains spike^{-1}. The maximum value for filled grains spike^{-1} (27.95) was recorded in no salt (S_0) and the lowest (15.47) was observed in 15 dS m^{-1} (S_2)**.**

4.5.3 Effect of priming agent

Filled grain spike^{-1} of wheat was significantly influenced by different priming treatment (Figure 5). The highest filled grain spike^{-1} (24.59) was obtained from P_1 (5 % PEG) followed by 2% mannitol (P_2). The lowest one (19.98) was obtained from no primimg (P_0).



V_0 = ESWYT 5, V_1 = ESWYT 6, V_3 = BARI Gom 28; P_0 = Control (without priming), P_1 = 5 % PEG, P_2 = 2% Mannitol; S_0 = Control (No salt), S_1 = 10 dS m^{-1}, S_2 = 15 dS m^{-1}

Figure 5. Effect of variety, salt stress and priming treatment on filled grain spike^{-1} of wheat

4.5.4 Interaction effect of variety and salt stress

Filled grain spike^{-1} was significantly influenced by the interaction effect of variety and salt stress treatment on wheat (Table 1). The maximum filled grain spike^{-1} (31.39) was recorded in V_1S_0 which was statistically similar with V_2S_0. On the other hand, the lowest filled grain spike^{-1} was obtained from V_3S_2 and it was statistically similar with V_2S_2.

4.5.5 Interaction effect of variety and priming agent

Filled grain spike^{-1} was significantly influenced by the interaction of varieties and priming treatment (Table 2). The highest filled grain spike^{-1} (26.93) of wheat was recorded in the interaction of V_1P_1 which was statistically similar with a number of treatment combinations. The lowest filled grain spike^{-1} (18.08) of wheat was recorded in V_3P_0 and it was statistically identical V_2P_0.

4.5.6 Interaction effect of salt stress and priming agent

Filled grain spike^{-1} was significantly influenced by the interaction of salt stress and priming agent (Table 3). The highest filled grain spike^{-1} (30.28) of wheat was recorded in the interaction of S_0P_1 which was statistically similar with S_1P_1. The lowest filled grain spike^{-1} (14.75) of wheat was recorded in S_2P_0 which statistically similar with S_0P_0 and S_1P_0.

4.5.7 Interaction effect of variety, salt stress and priming treatment

Filled grain spike^{-1} was significantly influenced by the interaction effect of variety, salt stress and priming treatment on wheat (Table 4). The maximum filled grain spike^{-}

$^{-1}$ (34.10) was recorded in $V_1S_0P_1$. On the other hand, the lowest filled grain spike^{-1}(10.50) was obtained from $V_3S_2P_0$ which was statistically identical with a number of treatment combinations.

4.6 Total grain spike^{-1}

4.6.1 Effect of variety

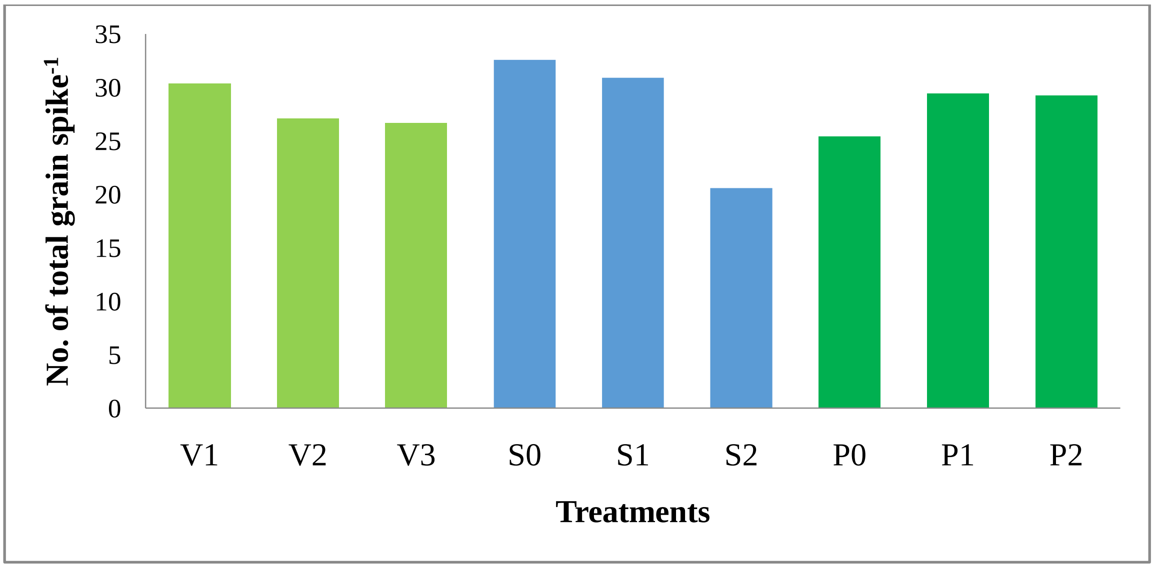
The data pertaining to number of total grain spike^{-1}as influenced by varieties has been presented in the Figure 6. Significantly highest number of total grain spike^{-1}(30.33) was recorded in ESWYT 5 (V_1) and the lowest in BARI Gom 28 (V_3) which was statistically similar with ESWYT 6 (V_2).

4.6.2 Effect of salt stress

The result on total grain spike^{-1} of wheat was significantly affected due to salt stress (Figure 6). The maximum total grain spike^{-1} (32.57) was found with no salt (S_0). The lowest value (20.57) of total grain spike^{-1} was recorded in 15 dS m^{-1} (S_2).

4.6.3 Effect of priming agent

Significant differences were noticed in respect of total grain spike^{-1}due to different priming treatment (Figure 6). Among the different treatments, the highest total grain spike^{-1}(29.43) was recorded in P_1 (5% PEG) which was statistically similar with 2% mannitol (P_2).The lowest total grain spike^{-1} (25.38) obtained from without priming (P_0).



V_0 = ESWYT 5, V_1 = ESWYT 6, V_3 = BARI Gom 28; P_0 = Control (without priming), P_1 = 5 % PEG, P_2 = 2% Mannitol; S_0 = Control (No salt), S_1 = 10dS^{-1}, S_2 = 15dS^{-1}

Figure 6. Effect of variety, salt stress and priming treatment on total grain spike^{-1} of wheat

4.6.4 Interaction effect of variety and salt stress

Data regarding on the number of total grain spike^{-1} are noticed in Table 1. In the experiment it was showed that total number of grain spike^{-1} was significantly influenced by interaction effect of varieties and different salt stress. The highest total grain spike^{-1} (34.91) was recorded with V_1S_0 followed by V_2S_0, V_3S_0. The lowest total grain spike^{-1} (16.36) was obtained from V_3S_2 which was statistically similar with V_2S_2.

4.6.5 Interaction effect of variety and priming agent

Data regarding on the number of total grain spike^{-1} are given in Table 2. Results revealed that the highest total grain spike^{-1}(32.45) was recorded with V_1P_1 followed by V_2P_1. The lowest total grain spike^{-1} (23.70) was obtained from V_3P_0 which was statistically similar with V_2P_0.

4.6.6 Interaction effect of salt stress and priming agent

Data regarding on the number of total grain spike^{-1} are placed in Table 3. Number of total grain spike^{-1} was significantly influenced by interaction effect of salt stress and priming agent. Results revealed that the highest total grain spike^{-1} (35.55) was recorded with S_0P_1 followed by S_1P_1 and S_2P_1. The lowest total grain spike^{-1}(19.40) was obtained from S_2P_0 which was statistically similar with S_0P_0 and S_1P_0.

4.6.7 Interaction effect of variety, salt stress and priming treatment

Data regarding the number of total grain spike^{-1} are given in Table 4. In the experiment it was found that number of total grain spike^{-1} was significantly influenced by interaction effect of variety, salt stress and priming treatment. Results revealed that the highest total grain spike^{-1}(38.79) was recorded with $V_1S_0P_{1.}$ The lowest total grain spike^{-1}(15.40) was obtained from $V_3S_2P_{0.}$

Table 4. Interaction effect of variety, salt stress and priming agent on yield attributes of wheat

Treatment	Plant Height (cm)	Effective tillers hill^{-1}	Spike Hill^{-1}	Spike Length (cm)	Filled grain spike^{-1} (no.)	Total grain spike^{-1} (no.)
$\mathbf{V_1S_0P_0}$	67.2	7.80 e-i	4.21 d-h	6.90 d-g	21.50 e-g	25.60 h
$\mathbf{V_1S_0P_1}$	75.67	11.65 a	8.00 a	11.60 a	34.10 a	38.79 a
$\mathbf{V_1S_0P_2}$	73.03	11.33 ab	7.49 ab	10.60 ab	32.63 ab	38.21 ab
$\mathbf{V_1S_1P_0}$	66.6	7.60 e-i	3.33 f-h	6.50 e-g	13.55 h-i	18.90 i
$\mathbf{V_1S_1P_1}$	72.8	10.70 a-c	6.70 a-c	9.60 a-c	32.10 ab	37.80 a-c
$\mathbf{V_1S_1P_2}$	72.8	10.67 a-c	6.61 a-c	9.50 a-c	30.85 a-c	35.85 a-d
$\mathbf{V_1S_2P_0}$	64.88	7.00 g-i	3.00 gh	6.49 e-g	11.40 i	15.80 i

Table 4 Cont'd

Treatment	Plant Height (cm)	Effective tillers hill^{-1}	Spike Hill^{-1}	Spike Length (cm)	Filled grain spike^{-1} (no.)	Total grain spike^{-1} (no.)
$V_1S_2P_1$	71.1	9.80 b-f	6.00 b-d	8.60 b-e	27.50 b-d	32.75 b-g
$V_1S_2P_2$	68.66	8.00 d-i	4.80 c-g	7.00 d-g	24.10 d-g	28.69 f-h
$V_2S_0P_0$	67	7.70 e-i	4.00 e-h	6.80 e-g	18.56 f-h	25.57 h
$V_2S_0P_1$	69.83	9.60 b-f	5.75 b-e	8.00 c-f	26.67 b-e	30.55 d-h
$V_2S_0P_2$	69.6	9.33 b-g	5.33 b-e	7.60 c-g	25.70 c-e	30.11 d-h
$V_2S_1P_0$	65.75	7.55 e-i	3.33 fg	6.50 e-g	11.55i	17.89 i
$V_2S_1P_1$	71.15	10.30 a-d	6.40 a-c	9.00 b-d	30.55 a-c	34.75 a-e
$V_2S_1P_2$	68.83	8.60 c-i	5.00 b-f	7.00 d-g	24.50 d-g	29.40 e-h
$V_2S_2P_0$	64.85	6.82 h-i	3.00 gh	6.00 fg	11.35 i	15.67 i
$V_2S_2P_1$	70.7	9.75 b-f	5.80 b-e	8.00 c-f	27.36 b-e	31.78 c-g
$V_2S_2P_2$	68.6	7.92 d-i	4.80 c-g	7.00 d-g	22.20 d-g	28.55 f-h
$V_3S_0P_0$	66.75	7.65 e-i	4.00 e-h	6.50 e-g	18.55 g-h	25.00 h
$V_3S_0P_1$	69	8.70 c-i	5.00 b-f	7.50 cg	24.55 d-f	29.67 e-h
$V_3S_0P_2$	69.2	8.85 c-h	5.10 b-f	7.50 c-g	25.35 c-e	29.90 d-h
$V_3S_1P_0$	65.28	7.35 f-i	3.25 gh	6.50 e-g	11.55 i	17.80 i
$V_3S_1P_1$	71.1	9.85 b-e	6.00 b-d	9.00 b-d	27.74 b-d	34.55 a-f
$V_3S_1P_2$	68.75	8.60 c-i	4.80 c-g	7.00 d-g	24.30 d-g	28.80 e-h
$V_3S_2P_0$	64.84	6.33 i	2.71 h	5.50 g	10.50 i	15.40 i
$V_3S_2P_1$	70.2	9.65 b-f	5.80 b-e	8.00 c-f	26.74 b-e	30.90 d-h
$V_3S_2P_2$	67.67	7.85 d-i	4.33 d-h	7.00 d-g	21.50 e-g	27.68 g-h
CV (%)	**10.5**	**9.74**	**11.09**	**9.87**	**11.45**	**8.97**
LSD $_{(0.05)}$	**NS**	**2.45**	**1.9080**	**2.1415**	**5.9918**	**6.0351**

V_1S_0P0 = ESWYT 5 × Control (no salt) × Control (no priming); $V_1S_0P_1$ = ESWYT 5 × Control (no salt) × 5% PEG; $V_1S_0P_2$ = ESWYT 5 × Control (no salt) × 2% Mannitol; $V_1S_1P_0$ = ESWYT 5 × 10 dS m^{-1} × Control (no priming); $V_1S_1P_1$ = ESWYT 5 × 10 dS m^{-1} × 5% PEG; $V_1S_1P_2$ = ESWYT 5 × 10 dS m^{-1} × 2% Mannitol; $V_1S_2P_0$ = ESWYT 5 × 15 dS m^{-1} × Control (no priming); $V_1S_2P_1$ = ESWYT 5 × 15 dS m^{-1} × 5% PEG; $V_1S_2P_2$ = ESWYT 5 × 15 dS m^{-1} × 2% Mannitol; $V_2S_0P_0$ = ESWYT 6 × Control (no salt) × V_2Control (no priming); $V_2S_0P_1$ = ESWYT 6 × Control; (no salt) × 5% PEG; $V_2S_0P_2$ = ESWYT 6 × Control (no salt) × 2%; Mannitol; $V_2S_1P_0$ = ESWYT 6 × 10 dS m^{-1} × Control (no priming); $V_2S_1P_1$ = ESWYT 6 × 10 dS m^{-1} × 5% PEG; $V_2S_1P_2$ = ESWYT 6 × 10 dS m^{-1} × 2% Mannitol; $V_2S_2P_0$ = ESWYT 6 × 15 dS m^{-1} × Control (no priming); $V_2S_2P_1$ = ESWYT 6 × 15 dS m^{-1} × 5% PEG; $V_2S_2P_2$ = ESWYT 6 × 15 dS m^{-1} × 2% Mannitol; $V_2S_0P_0$= BARI Gom 28 × Control (no salt) × Control (no priming); $V_3S_0P_1$ = BARI Gom 28 × Control (no salt) × 5% PEG; $V_3S_0P_2$ = BARI Gom 28 × Control (no salt) × 2% Mannitol; $V_3S_1P_0$ = BARI Gom 28 × 10 dS m^{-1} × Control (no priming); $V_3S_1P_1$ = BARI Gom 28 × 10 dS m^{-1} × 5% PEG; $V_3S_1P_2$ = BARI Gom 28 × 10 dS m^{-1} × 2% Mannitol; $V_3S_2P_0$ = BARI Gom 28 × 15 dS m^{-1} × Control (no priming); $V_3S_2P_1$ = BARI Gom 28 × 15 dS m^{-1} × 5% PEG; $V_3S_2P_2$ = BARI Gom 28 × 15 dS m^{-1} × 2% Mannitol

4.7 1000-grain weight (g)

4.7.1 Effect of variety

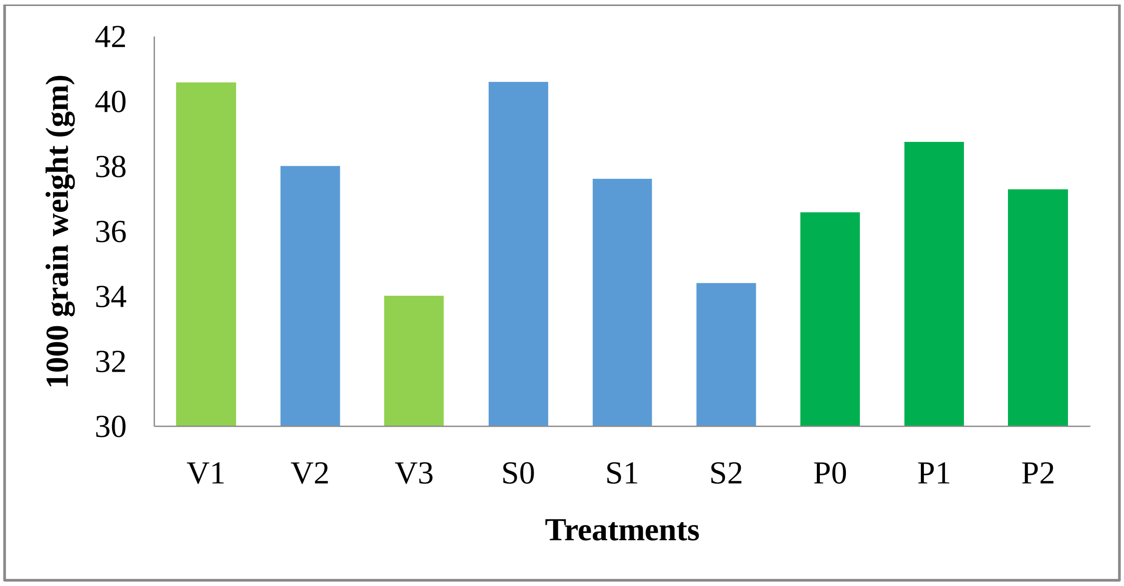
1000 grain weight was significantly affected by wheat varieties (Figure 9). The highest 1000 grain weight (40.58 g) was obtained from ESWYT 5 (V_1). The lowest 1000 grain weight (34.02 g) was found in BARI Gom 28 (V_3).

4.7.2 Effect of salt stress

The data the 1000 grain weight of wheat as affected by different salt stress are presented in Figure 9. Result noticed that the 1000 grain weight decreased significantly by salinity increase. The maximum 1000 grain weight (40.60 gm) was observed in no salt (S_0) and the lowest (3.77) at 15 dS m^{-1} (S_2).

4.7.3 Effect of priming agent

1000-grain weight of wheat was significantly influenced by different priming treatment (Figure 9). The highest 1000-grain weight (38.75 g) was obtained from P_1 (5% PEG). The lowest 1000-grain weight (36.59 g) from no priming (P_0) followed by 2% mannitol (P_2).



V_0 = ESWYT 5, V_1 = ESWYT 6, V_3 = BARI Gom 28; P_0 = Control (without priming), P_1 = 5 % PEG, P_2 = 2% Mannitol; S_0 = Control (No salt), S_1 = 10 dS m^{-1}, S_2 = 15 dS m^{-1}

Figure 7. Effect of variety, salt stress and priming treatment on 1000-grain Weight of wheat

4.7.4 Interaction effect of variety and salt stress

Interaction between variety and salt stress was affected significantly on 1000-grain weight (Table 5). The highest 1000-grain weight (41.46 g) was obtained from the interaction treatment of V_1S_0 which was statistically identical with V_1S_1 and V_3S_0. The lowest 1000-grain weight (26.90 g) was recorded in interaction of V_3S_2.

4.7.5 Interaction effect of variety and priming agent

1000 grain weight was significantly influenced by the interaction of varieties and priming treatment (Table 6). The highest 1000-grain weight (41.58 g) of wheat was recorded in the interaction of V_1P_1 which was statistically similar with a number of treatment combinations. The lowest 1000 grain weight (31.45 g) of wheat was in V_3P_0.

4.7.6 Interaction effect of salt stress and priming agent

1000 grain weight was significantly influenced by the interaction of salt stress and priming agent (Table 7). The highest 1000-grain weight (41.30 g) of wheat was recorded in the interaction of S_0P_1 which was statistically similar with S_0P_2, S_1P_1 and S_2P_1. The lowest 1000 grain weight (32.39 g) of wheat was recorded in S_2P_0 which statistically similar S_1P_0.

Table 5. Interaction effect of variety and salt stress on yield and harvest index of wheat

Treatment	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest Index (%)
V_1S_0	41.46 a	5.244 a	6.2298 a	39.260 a
V_1S_1	40.98 a	4.716 ab	5.6911 a	39.137 a
V_1S_2	39.32 ab	4.068 b	5.0756 b	39.000 a
V_2S_0	39.35 ab	4.896 a	5.4293 bc	38.863 a
V_2S_1	37.70 b	4.596 ab	5.501 b-d	38.600 ab
V_2S_2	37.00 bc	2.88 c	4.4142 d	37.490 bc
V_3S_0	41.00 a	2.532 cd	5.1911 cd	37.093 c
V_3S_1	34.17 c	4.668 ab	4.9778 b-d	36.573 c
V_3S_2	26.90 d	2.04 d	4.6609 d	36.383 c
CV (%)	**5.6**	**6.07**	**8.45**	**6.47**
LSD $_{(0.05)}$	**3.2056**	**0.6579**	**0.623**	**1.20**

V_1S_0 = ESWYT 5 × S_0 = Control (No salt); V_1S_1 = ESWYT 5 × 10dS m^{-1} ; V_1S_2 = ESWYT 5 × 15 dS m^{-1} ; V_2S_0 = ESWYT 6 × S_0 = Control (No salt); V_2S_1 = ESWYT 6 × 10 dS m^{-1} ; V_2S_2 = ESWYT 6 × 15 dS m^{-1}; V_3S_0 = BARI Gom 28 × S_0 = Control (No salt); V_3S_1 = BARI Gom 28 × 10 dS m^{-1} and V_3S_2 = BARI Gom 28 × 15 dS m^{-1} .

4.7.7 Interaction effect of variety, salt stress and priming treatment

1000 grain weight was significantly influenced by the interaction effect of variety, salt stress and priming treatment on wheat (Table 8). The maximum 1000 grain weight (42.71 g) was recorded in $V_1S_0P_1$. On the other hand, the lowest 1000 grain weight (24.00 g) was obtained from $V_3S_2P_0$ which was statistically identical with $V_3S_2P_0$. $V_3S_2P_0$

4.8 Grain yield (t ha^{-1})

4.8.1 Effect of variety

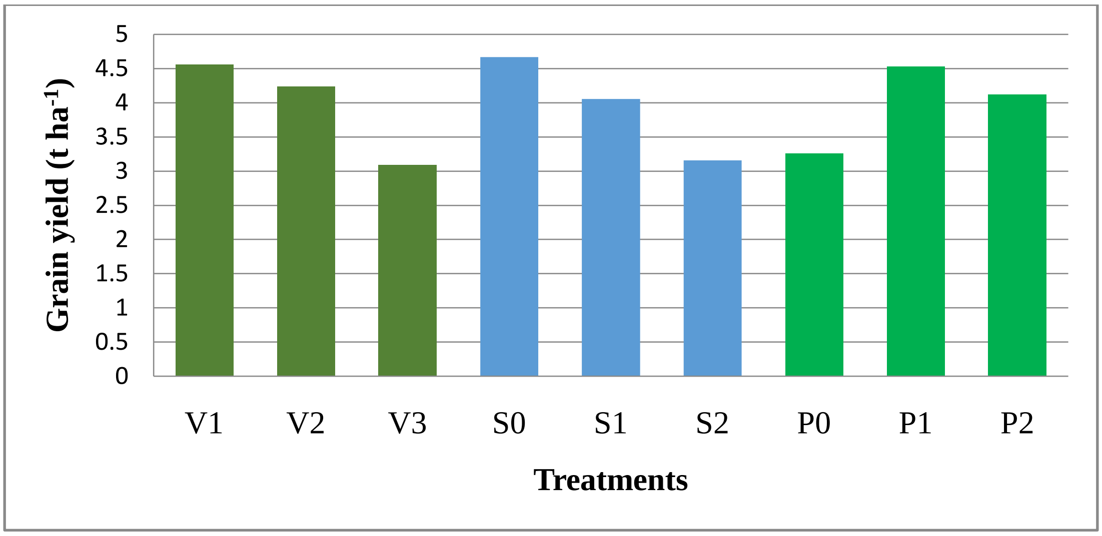
The data pertaining to grain yield $plant^{-1}$of wheat at harvest presented in Fig. 7. ESWYT 5 (V_1) significantly showed highest grain yield (4.56 t ha^{-1}) which was statistically identical with ESWYT 6 (V_2). The lowest grain yield (3.08 t ha^{-1}) was found in BARI Gom 28 (V_3).

4.8.2 Effect of salt stress

Grain yield $plant^{-1}$ of wheat at harvest as influenced by different salt stress levels are presented in Fig. 7. It is noticed that grain yield $plant^{-1}$of was significant with salt stress. The highest grain yield (4.66 t ha^{-1}) was obtained from No salt (S_0).). The lowest grain yield (3.15 t ha^{-1}) was found in 15 dS m^{-1} (S_2).

4.8.3 Effect of priming agent

The influence of priming agent on grain yield $plant^{-1}$ of wheat showed significant variation (Fig. 7). The results indicated that the different priming agent significantly increased effective tillers $hill^{-1}$ compared to without priming (P_0). The highest grain yield (4.52 t ha^{-1}) was recorded with 5% PEG (P_1). The lowest grain yield (3.25 t ha^{-1}) was obtained from without priming (P_0).



V_0 = ESWYT 5, V_1 = ESWYT 6, V_3 = BARI Gom 28; P_0 = Control (without priming), P_1 = 5 % PEG, P_2 = 2% Mannitol; S_0 = Control (No salt), S_1 = 10 dS m^{-1}, S_2 = 15 dS m^{-1}

Figure 8. Effect of variety and salt stress on grain yield of wheat

4.8.4 Interaction effect of variety and salt stress

Grain yield was significantly influenced by the interaction effect of varieties and salt stress. The findings are manifested in Table 5. The highest grain yield (5.24 t ha^{-1}) was recorded in interaction of V_1S_0 which was statistically similar with V_2S_0. On the other hand, the lowest value (2.04 t ha^{-1}) was obtained from V_3S_2 which was statistically similar with V_3S_0.

Table 6. Interaction effect of variety and priming agent on yield and harvest index of wheat

Treatment	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest Index (%)
V_1P_0	35.40 d	3.468 d	4.086 d	34.847 b-d
V_1P_1	41.58 a	5.448 a	6.472 a	41.307 a
V_1P_2	39.43 a-c	4.476 bc	5.436 bc	39.197 b
V_2P_0	35.21 d	3.468 d	3.889 d	34.250 cd
V_2P_1	40.14 ab	4.632 b	5.776 b	40.867 ab
V_2P_2	38.26 b-d	3.972 b-d	5.028 c	39.267 bc
V_3P_0	31.45 e	1.8 3 e	3.853 d	32.187 d
V_3P_1	40.03 ab	4.572 bc	6.082 b	41.297 ab
V_3P_2	36.35 cd	3.792 cd	4.893 c	39.183 bc
CV (%)	**6.5**	**7.00**	**8.45**	**6.55**
LSD $_{(0.05)}$	**3.2056**	**0.6579**	**0.423**	**2.1848**

V_1P_0 = ESWYT 5 × Control (no priming); V_1P_1 = ESWYT 5 × 5% PEG; V_1P_2 = ESWYT 5 × 2% Mannitol; V_2P_0 = ESWYT 6 × Control (no priming); V_2P_1 = ESWYT 6 × 5% PEG; V_2P_2 = ESWYT 6 × 2% Mannitol; V_3P_0 = BARI Gom 28 × Control (no priming); V_3P_1 = BARI Gom 28 × 5% PEG and V_3P_2 = BARI Gom 28 × 2% Mannitol.

4.8.5 Interaction effect of variety and priming agent

Interaction effect of varieties and priming treatment significantly influenced grain yield t ha^{-1} (Table 6). Results indicated that the highest grain yield (5.448 t ha^{-1}) was with interaction of V_1P_1 which was statistically different from all interaction. On the other hand, the lowest result was obtained from V_3P_0 (1.83 t ha^{-1}).

4.8.6 Interaction effect of salt stress and priming agent

Interaction effect of salt stress and priming agent had a significant influence on grain yield t ha^{-1} (Table 7). Results indicated that the highest grain yield (5.12 t ha^{-1}) was with interaction of S_1P_1 which differed statistically from all other combination. On the other hand, the lowest result was obtained from S_2P_0 (2.1 t ha^{-1}) followed by S_0P_0 and S_1P_2.

4.8.7 Interaction effect of variety, salt stress and priming treatment

Interaction among variety, salt stress and priming treatment was observed significantly positive effect on grain yield (t ha^{-1}) (Table 8). The maximum grain yield (4.88 t ha^{-1}) was observed in interaction treatment of $V_1S_0P_1$ as compared to other interactions. The lowest grain yield (1.6 t ha^{-1}) was noticed in interaction of $V_3S_2P_0$.

4.9 Straw yield (t ha^{-1})

4.9.1 Effect of variety

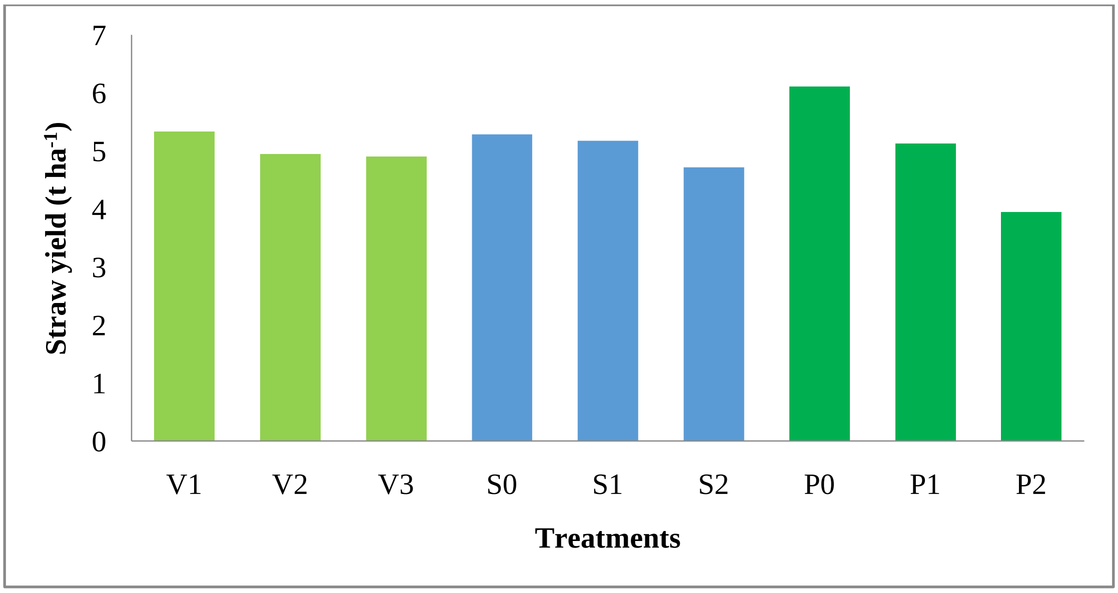
The number of straw yield was significantly influenced due to different varieties (Fig. 8). Result revealed that the maximum straw yield (5.33 t ha^{-1}) was observed in ESWYT 5 (V_1) and lowest straw yield (4.89 t ha^{-1}) was obtained from BARI Gom 28 (V_3) which was statistically similar with ESWYT 6 (V_2).

4.9.2 Effect of salt stress

Straw yield of wheat differed significantly due to different salt stress on wheat (Fig. 8). The maximum straw yield (5.28 t ha^{-1}) was obtained from no salt (S_0) which was statistically identical with 10 dS m^{-1}(S_1) and the lowest (4.71 t ha^{-1}) was observed in 15 dS m^{-1} (S_2).

4.9.3 Effect of priming agent

Straw yield of wheat differed significant due to different priming treatment (Fig. 8). The highest straw yield (6.11 t ha^{-1}) was recorded with P_1 (5% PEG). The lowest straw yield (3.94 t ha^{-1}) was obtained from no priming (P_0).



V_0 = ESWYT 5, V_1 = ESWYT 6, V_3 = BARI Gom 28; P_0 = Control (without priming), P_1 = 5 % PEG, P_2 = 2% Mannitol; S_0 = Control (No salt), S_1 = 10 dS m^{-1}, S_2 = 15 dS m^{-1}

Figure 9. Effect of variety, salt stress and priming treatment on straw yield of wheat

4.9.4 Interaction effect of variety and salt stress

Interaction between varieties and salt stress was observed significantly positive effect on straw yield (t ha^{-1}) (Table 5). The maximum straw yield (6.22 t ha^{-1}) was observed in interaction treatment of V_1S_0 compared to others interactions and was statistically similar with V_1S_1. The lowest straw yield (4.41 t ha^{-1}) was noticed in interaction of

V_3S_2 keeping a statistically similar relationship with a number of treatment combinations.

4.9.5 Interaction effect of variety and priming agent

Interactions of variety and priming treatment had a significant influenced on the straw yield of wheat (Table 6). It was observed that V_1P_1 treatment interaction produced the highest straw yield (6.47 t ha^{-1}) of wheat which was statistically different from all other interaction. However, the lowest straw yield (3.85 t ha^{-1}) was recorded from V_3P_0 which was statistically similar with V_1P_0 and V_2P_0.

Table 7. Interaction effect of salt stress and priming agent on yield and harvest Index of wheat

Treatment	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest Index (%)
S_0P_0	36.50 de	2.34 d	4.412 cd	36.58 d
S_0P_1	41.30 a	4.716 a	6.147 a	40.83 ab
S_0P_2	38.43 a-d	4.332 bc	5.300 b	39.31 bc
S_1P_0	34.40 ef	2.16 d	4.022 de	33.57 e
S_1P_1	40.78 ab	5.112 b	6.050 a	41.35 a
S_1P_2	37.76 b-d	4.116 c	5.447 b	40.28 ab
S_2P_0	32.39 f	2.1 d	3.395 e	31.12 f
S_2P_1	39.72 a-c	4.08 bc	6.134 a	41.27 a
S_2P_2	36.65 c-e	2.34 c	4.611 c	38.04 cd
CV (%)	**5.65**	**7.00**	**6.7**	**12.5**
$LSD_{0.05}$	**3.25**	**0.65**	**0.423**	**2.184**

S_0P_0 = Control (no salt) × Control (no priming); S_0P_1 = Control (no salt) × 5% PEG; S_0P_2 = Control (no salt) × 2% Mannitol; S_1P_0 = 10 dS m^{-1} × Control (no priming); S_1P_1 = 10 dS m^{-1} × 5% PEG; S_1P_2 = 10 dS m^{-1} × 2% Mannitol; S_2P_0 = 15 dS m^{-1} × Control (no priming); S_2P_1 = 15 dS m^{-1} × 5% PEG; S_2P_2 = 15 dS m^{-1} × 2% Mannitol

4.9.6 Interaction effect of salt stress and priming agent

Interactions of salt stress and priming agent had a significant influenced on the straw yield of wheat (Table 7). The maximum straw yield (6.14 t ha^{-1}) was obtained from S_0P_1 which was statistically similar with S_1P_1 and S_2P_1. However, the lowest straw yield (3.39 t ha^{-1}) was recorded in S_2P_0 which was statistically similar with S_1P_0.

4.9.7 Interaction effect of variety, salt stress and priming treatment

Interaction among variety, salt stress and priming treatment had a significant on straw yield (Table 8). The highest straw yield (11.80 t ha^{-1}) was obtained from the interaction treatment of $V_1S_0P_1$. The lowest straw yield plant^{-1} (3.35 t ha^{-1}) was recorded in interaction of $V_3S_2P_0$.

4.10 Harvest Index (%)

4.10.1 Effect of variety

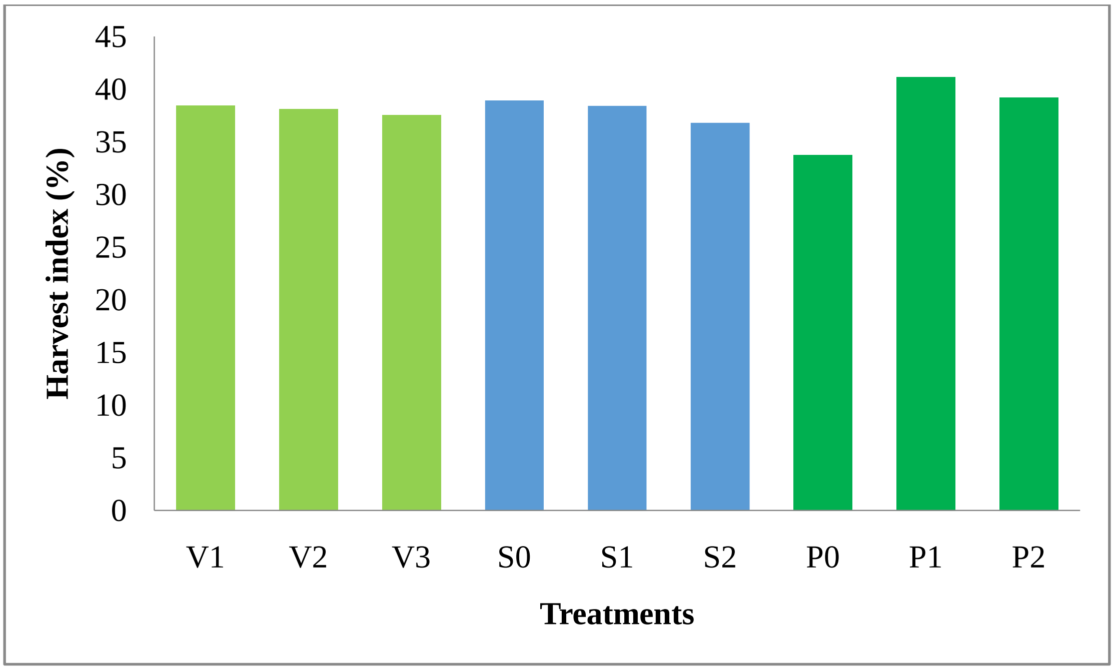
The data pertaining to number of harvest index (%) was not significantly influenced by varieties has been presented in the Fig. 10. But numerically highest harvest index (38.45%) was recorded in ESWYT 5 (V_1) and the lowest in (BARI Gom 28 (V_3) which was statistically similar with ESWYT 6 (V_2).

4. 10.2 Effect of salt stress

Significant differences were noticed in respect of Harvest Index (%) in wheat due to salt stress (Fig. 10). Among the treatment of salt stress, the highest harvest Index (38.91%) was recorded in no salt (S_0). The lowest harvest index (36.81%) was obtained from 15 dS^{-1} (S_2) which was statistically similar with 10 dS^{-1} (S_1).

4. 10.3 Effect of priming agent

Significant differences were noticed in respect of harvest index (%) due to different priming treatment (Fig. 10). Among the different treatments, the highest (41.15%) harvest index (%) was recorded in P_1 (5% PEG). The lowest (33.76%) harvest index obtained from without priming (P_0) which was statistically similar with 2% Mannitol (P_2).



V_0 = ESWYT 5, V_1 = ESWYT 6, V_3 = BARI Gom 28; P_0 = Control (without priming), P_1 = 5 % PEG, P_2 = 2% Mannitol; S_0 = Control (No salt), S_1 = 10 dS m^{-1}, S_2 = 15 dS m^{-1}

Figure 10. Effect of variety, salt stress and priming treatment on harvest index of wheat

4. 10.4 Interaction effect of variety and salt stress

Data on harvest index are shown in Table 5, which was significantly influenced by interaction effect of varieties and salt stress treatment. Results showed that the highest harvest index (39.26%) was observed in V_1S_0 which was statistically similar with V_1S_1. The lowest harvest index (36.38%) was obtained from V_3S_2 which was statistically similar with a number of treatment combinations.

4. 10.5 Interaction effect of variety and priming agent

Data regarding harvest index (%) are placed in Table 6. From the experiment it was found that harvest index was significantly influenced by interaction effect of varieties and different priming treatment. Results revealed that the highest (41.30%) harvest index was recorded with V_1P_1 followed by V_2P_1, V_3P_1. The lowest (32.18%) harvest index was obtained from V_3P_0 which was statistically similar with V_1P_0 and V_2P_0.

4. 10.6 Interaction effect of salt stress and priming agent

Data regarding the effect of salt stress and priming agent interaction on harvest index are given in Table 7. Results revealed that the highest (41.35%) harvest index was recorded with S_1P_1 and it was statistically similar with a number of treatment combinations. The lowest (31.12%) harvest index (%) was obtained from S_2P_0 which was statistically similar with S_1P_0 and S_0P_0.

4. 10.7 Interaction effect of variety, salt stress and priming treatment

Data regarding the effect of variety, salt stress and priming agent interaction on harvest index (%) are placed in Table 8. Harvest index was significantly influenced by interaction effect of variety, salt stress and priming treatment. Results revealed that the highest (41.47%) harvest index was recorded with $V_1S_0P_1$. The lowest (33.33%) harvest index (%) was obtained from $V_3S_2P_0$.

Table 8. Interaction effect of variety, salt stress and priming agent on yield and harvest index of wheat

Treatment	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest Index (%)
$V_1S_0P_0$	37.36 a-c	2.88 g-i	6.70 d-g	41.50 a
$V_1S_0P_1$	42.71 a	4.884 a	11.80 a	41.47 a
$V_1S_0P_2$	41.75 ab	2.904 ab	10.80 ab	40.38 abc
$V_1S_1P_0$	35.60 a-c	2.4 hi	6.50 e-g	40.38 abc
$V_1S_1P_1$	41.70 ab	4.692 a-c	9.70 bc	40.04 abc
$V_1S_1P_2$	41.40 a-c	4.728 a-c	9.60 bc	37.19 cd
$V_1S_2P_0$	29.50 de	1.8 ij	6.00 fg	37.11 cd
$V_1S_2P_1$	40.80 a-c	4.68 b-e	8.50 c-e	36.99 cd
$V_1S_2P_2$	38.70 ac	3.6 e-h	7.50 d-g	41.50 a

Table 8 Cont'd

Treatment	1000-grain weight	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest Index (%)
$V_2S_0P_0$	35.70 b-d	2.844 g-i	4.5600 d-g	35.65 d
$V_2S_0P_1$	39.70 a-c	4.02 e-h	6.5613 a	35.29 de
$V_2S_0P_2$	40.30 a-c	4.2 e-g	4.5680 ab	32.14 ef
$V_2S_1P_0$	34.75 c-d	2.4 hi	4.2333 e-g	35.29 de
$V_2S_1P_1$	41.05 a-c	4.8 a-c	6.4307 bc	30.47 f
$V_2S_1P_2$	39.50 a-c	3.96 e-h	6.4093 bc	35.45 d
$V_2S_2P_0$	27.20 e	1.56 ij	3.4667 fg	30.77 f
$V_2S_2P_1$	40.62 ac	4.668 b-e	6.4267 c-e	41.22 a
$V_2S_2P_2$	38.20 ac	3.00 f-i	5.3333 d-g	41.20 a
$V_3S_0P_0$	35.60 b-d	2.484 h-i	4.5147 e-g	41.38 a
$V_3S_0P_1$	40.31 a-c	4.536 d-f	5.6733 c-f	41.18 ab
$V_3S_0P_2$	39.80 a-c	4.2 e-g	6.1000 c-f	39.92 abc
$V_3S_1P_0$	29.56 d-e	1.8 ij	3.8000 fg	41.45 a
$V_3S_1P_1$	40.80 a-c	4.86 a-d	5.7667 cd	41.20 a
$V_3S_1P_2$	38.80 a-c	3.84 e-h	4.9867 cf	39.13 abc
$V_3S_2P_0$	24.00 e	1.6 j	3.3533 g	30.14 f
$V_3S_2P_1$	40.50 a-c	4.848 c-e	5.8893 c-e	37.50 bcd
$V_3S_2P_2$	37.75 a-c	3.00 f-i	4.0000 d-g	39.67 abc
CV (%)	**5.5**	**8.78**	**8.8**	**5.6**
LSD $_{(0.05)}$	**6.6926**	**1.3736**	**0.856**	**3.784**

V_1S_0P0 = ESWYT 5 × Control (no salt) × Control (no priming); $V_1S_0P_1$ = ESWYT 5 × Control (no salt) × 5% PEG; $V_1S_0P_2$ = ESWYT 5 × Control (no salt) × 2% Mannitol; $V_1S_1P_0$ = ESWYT 5 × 10 dS m^{-1} × Control (no priming); $V_1S_1P_1$ = ESWYT 5 × 10 dS m^{-1} × 5% PEG; $V_1S_1P_2$ = ESWYT 5 × 10 dS m^{-1} × 2% Mannitol; $V_1S_2P_0$ = ESWYT 5 × 15 dS m^{-1} × Control (no priming); $V_1S_2P_1$ = ESWYT 5 × 15 dS m^{-1} × 5% PEG; $V_1S_2P_2$ = ESWYT 5 × 15 dS m^{-1} × 2% Mannitol; $V_2S_0P_0$ = ESWYT 6 × Control (no salt) × V_2Control (no priming); $V_2S_0P_1$ = ESWYT 6 × Control; (no salt) × 5% PEG; $V_2S_0P_2$ = ESWYT 6 × Control (no salt) × 2%; Mannitol; $V_2S_1P_0$ = ESWYT 6 × 10 dS m^{-1} × Control (no priming); $V_2S_1P_1$ = ESWYT 6 × 10 dS m^{-1} × 5% PEG; $V_2S_1P_2$ = ESWYT 6 × 10 dS m^{-1} × 2% Mannitol; $V_2S_2P_0$ = ESWYT 6 × 15 dS m^{-1} × Control (no priming); $V_2S_2P_1$ = ESWYT 6 × 15 dS m^{-1} × 5% PEG; $V_2S_2P_2$ = ESWYT 6 × 15 dS m^{-1} × 2% Mannitol; $V_2S_0P_0$= BARI Gom 28 × Control (no salt) × Control (no priming); $V_3S_0P_1$ = BARI Gom 28 × Control (no salt) × 5% PEG; $V_3S_0P_2$ = BARI Gom 28 × Control (no salt) × 2% Mannitol; $V_3S_1P_0$ = BARI Gom 28 × 10 dS m^{-1} × Control (no priming); $V_3S_1P_1$ = BARI Gom 28 × 10 dS m^{-1} × 5% PEG; $V_3S_1P_2$ = BARI Gom 28 × 10 dS m^{-1} × 2% Mannitol; $V_3S_2P_0$ = BARI Gom 28 × 15 dS m^{-1} × Control (no priming); $V_3S_2P_1$ = BARI Gom 28 × 15 dS m^{-1} × 5% PEG; $V_3S_2P_2$ = BARI Gom 28 × 15 dS m^{-1} × 2% Mannitol

Plant sample analysis

4.11 N%

4.11.1 Effect of variety

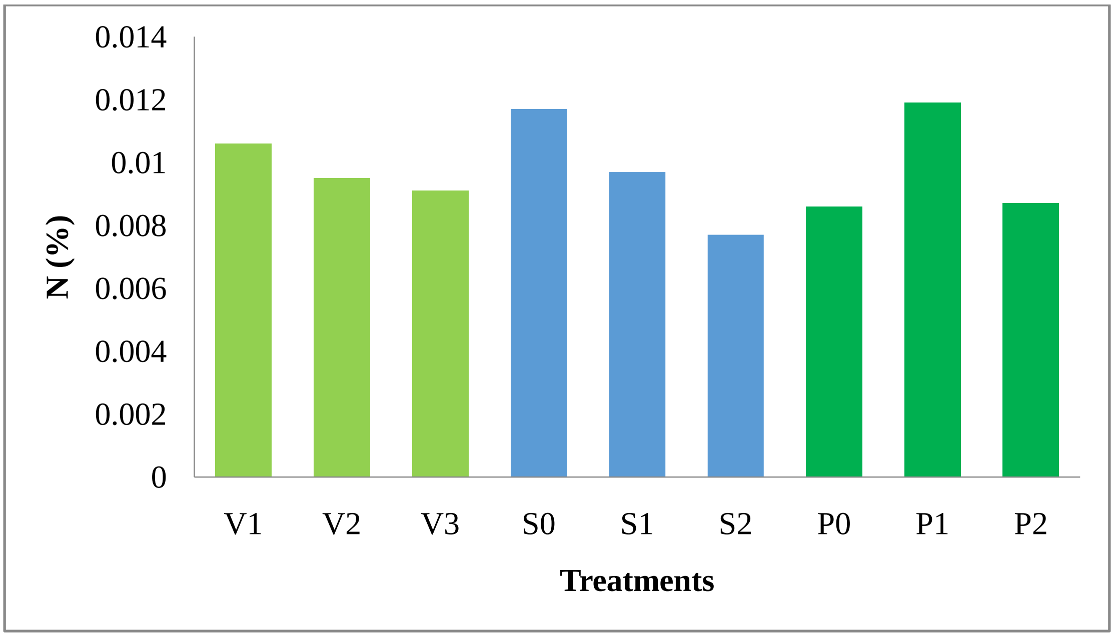
The data pertaining to N% of wheat plant in (Fig. 11) showed that the effect of variety on N% was insignificant.

4.11.2 Effect of salt stress

N% of wheat plant was influenced by different salt stress are presented in Fig. 11. It was noticed that N% of was non-significant with salt stress. But numerically the highest N% (0.0117) was obtained from no salt (S_0). The lowest N% (0.0077) was found from 15 dS m^{-1} (S_2).

4.11.3 Effect of priming agent

The data pertaining to N% of wheat plant in (Fig. 11) indicated that N % was not significant with priming treatment.



V_0 = ESWYT 5, V_1 = ESWYT 6, V_3 = BARI Gom 28; P_0 = Control (without priming), P_1 = 5 % PEG, P_2 = 2% Mannitol; S_0 = Control (No salt), S_1 = 10dS^{-1}, S_2 = 15dS^{-1}

Figure 11. Effect of variety, salt stress and priming treatment on N% of wheat plant

4.11.4 Interaction effect of variety and salt stress

N% was non-significantly influenced by the interaction effect of varieties and salt stress was manifested in Table 9. But numerically the highest N% (0.0143) was obtained from V_1S_0 whereas the lowest N% (0.0067) was found in V_3S_2.

Table 9. Interaction effect of variety and salt stress on plant nutrient of wheat

Treatment	N%	K%	Ca%
V_1S_0	0.0143	0.0413 a	0.0880 a
V_1S_1	0.0100	0.0293 bc	0.0846 a
V_1S_2	0.0075	0.0300 bc	0.0633 cd
V_2S_0	0.0088	0.0280 bc	0.0600 de
V_2S_1	0.0092	0.0286 bc	0.0806 ab
V_2S_2	0.0106	0.0316 a-c	0.0720 bc
V_3S_0	0.0103	0.0360 ab	0.05800 de
V_3S_1	0.0101	0.0300 bc	0.0880 a
V_3S_2	0.0067	0.0246 c	0.0526 e
LSD $_{(0.05)}$	**NS**	**0.01**	**0.01**
CV (%)	**10.00**	**10.20**	**13.89**

V_1S_0 = ESWYT 5 × S_0 = Control (No salt); V_1S_1 = ESWYT 5 × 10dS m^{-1} ; V_1S_2 = ESWYT 5 × 15 dS m^{-1} ; V_2S_0 = ESWYT 6 × S_0 = Control (No salt); V_2S_1 = ESWYT 6 × 10 dS m^{-1} ; V_2S_2 = ESWYT 6 × 15 dS m^{-1}; V_3S_0 = BARI Gom 28 × S_0 = Control (No salt); V_3S_1 = BARI Gom 28 × 10 dS m^{-1} and V_3S_2 = BARI Gom 28 × 15 dS m^{-1} .

4.11.5 Interaction effect of variety and priming agent

Interaction effect of varieties and priming agent treatment was non-significantly influence on N% (Table 10). But numerically the highest N% (0.0126) was obtained from V_1P_1. Meanwhile, the lowest N% (0.006) was found in V_3P_0 and V_2P_0.

4.11.6 Interaction effect of salt stress and priming agent

Interaction effect of salt stress and priming agent had an significant influence on N% (Table 11). Results indicated that the highest N% (0.017) was with interaction of S_0P_1 which was statistically similar with all combination except S_2P_0 as the lowest result was obtained from S_2P_0 (0.0061%).

4.11.7 Interaction effect of variety, salt stress and priming treatment

Interaction between variety, salt stress and priming treatment was observed non-significant (Table 12). But numerically the highest N% (0.02) was obtained from $V_1S_0P_1$ and the lowest N% (0.0040) was found in $V_3S_2P_0$.

4.12 K%

4.12.1 Effect of variety

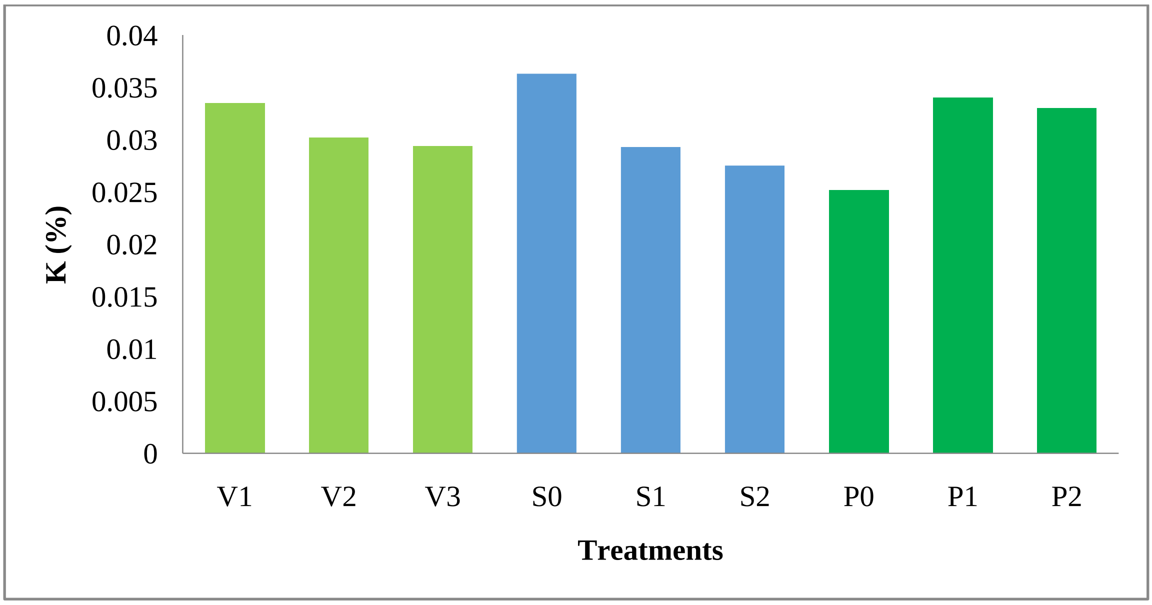
The data regarding K% of wheat plant in (Figure 12) indicated that K% was not significantly influenced by varieties.

4.12.2 Effect of salt stress

K% of wheat differed significantly due to different salt stress on wheat (Figure 12). The maximum K% (0.0363) was obtained from 15 dS m^{-1} (S_0). The lowest (0.0275%) was observed in 15 dS m^{-1} (S_2) which was statistically simialr with 10 dS m^{-1} (S_1).

4.12.3 Effect of priming agent

Application of priming treatment exerted significant affect on K% of wheat (Figure 12). The highest K% (0.0340) was measured with 5% PEG ($P_{1)}$ which was statistically similar with 2% mannitol (P_1). The lowest K% (0.0252) was measured with P_0 (without priming) treatment.



V_0 = ESWYT 5, V_1 = ESWYT 6, V_3 = BARI Gom 28; P_0 = Control (without priming),
P_1 = 5 % PEG, P_2 = 2% Mannitol; S_0 = Control (No salt), S_1 = 10 dS m^{-1}, S_2 = 15 dS m^{-1}

Figure 12. Effect of variety, salt stress and priming treatment on K% of wheat

4.12.4 Interaction effect of variety and salt stress

Interaction between varieties and salt stress was observed significantly positive effect on K% (Table 9). The maximum K% (0.0413) was observed in interaction treatment of V_1S_0 as compared to that of other interactions. The lowest K% (0.0246) was noticed in interaction of $V_3S_{2.}$

4.12.5 Interaction effect of variety and priming agent

Interactions of variety and priming treatment had a significant influenced on the K% of wheat (Table 10). It was observed that V_1P_1 treatment interaction produced the highest K% (0.0353) in wheat which was statistically identical with $V_1P_{0,}$ $V_1P_{2,}$ V_2P_1

and V_2P_2. However, the lowest K% (0.0206) was recorded in V_3P_0 which was statistically identical with V_3P_0.

Table 10. Interaction effect of variety and priming agent on plant nutrient of Wheat

Treatment	N%	K%	Ca%
V_1P_0	0.0094	0.0313 ab	0.0667 cd
V_1P_1	0.0126	0.0366 a	0.0873 a
V_1P_2	0.0104	0.0333 a	0.0740 bc
V_2P_0	0.006	0.0236 bc	0.0666 cd
V_2P_1	0.0117	0.0353 a	0.0793 ab
V_2P_2	0.0101	0.0333 a	0.0700 bc
V_3P_0	0.006	0.0206 c	0.0580 d
V_3P_1	0.0113	0.0340 a	0.0760 bc
V_3P_2	0.0101	0.0313 ab	0.0693 c
CV (%)	**6.44**	**6.84**	**6.26**
LSD $_{(0.05)}$	**NS**	**0.01**	**0.01**

V_1P_0 = ESWYT 5 × Control (no priming); V_1P_1 = ESWYT 5 × 5% PEG; V_1P_2 = ESWYT 5 × 2% Mannitol; V_2P_0 = ESWYT 6 × Control (no priming); V_2P_1 = ESWYT 6 × 5% PEG; V_2P_2 = ESWYT 6 × 2% Mannitol; V_3P_0 = BARI Gom 28 × Control (no priming); V_3P_1 = BARI Gom 28 × 5% PEG and V_3P_2 = BARI Gom 28 × 2% Mannitol.

4.12.6 Interaction effect of salt stress and priming agent

Interactions of salt stress and priming agent had a significant influence on the K% wheat (Table 11). The maximum K% (0.0406) was obtained from S_0P_1 which was statistically similar with S_0P_2, S_1P_1 and S_2P_1. However, the lowest K% (0.0166) was recorded in S_2P_0.

4.12.7 Interaction effect of variety, salt stress and priming treatment

Interaction between variety, salt stress and priming treatment was affected significantly on K% (Table 12). The highest K% (0.0440) was obtained from the interaction treatment of $V_1S_0P_1$. The lowest K% (0.0040) was recorded in interaction of $V_3S_2P_0$.

4.13 Ca%

4.13.1 Effect of variety

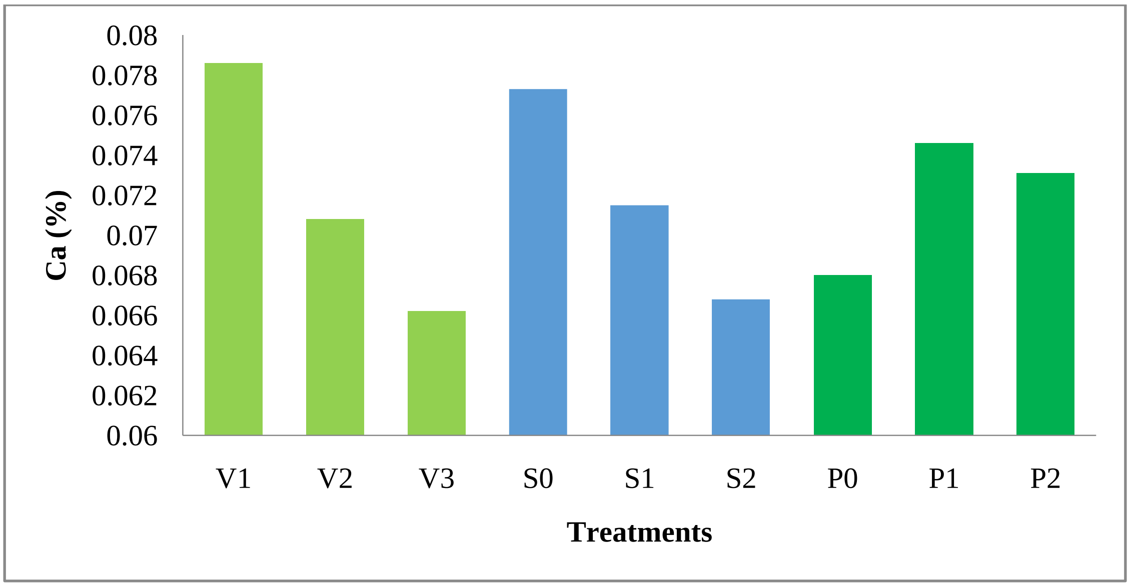
Ca% was significantly affected by wheat varieties (Figure 13). The highest Ca% (0.0786) was obtained from ESWYT 5 (V_1). The lowest Ca% (0.0662) was found in BARI Gom 28 (V_3)

4.13.2 Effect of salt stress

The data regarding Ca% of wheat plant as affected by different salt stress are presented in Figure 13. Result revealed that the Ca% was decreased significantly by salinity increase. The maximum Ca% (0.0773) was observed in no salt (S_0) which was statistically similar with 10 dS m^{-1} (S_1) and the lowest (0.0668) at 15 dS m^{-1} (S_2).

4.13.3 Effect of priming agent

Ca% of wheat was significantly influenced by different priming treatment (Figure 13). The highest Ca% (0.0746) was obtained from 5% PEG (P_1) which was statistically similar with 2% mannitol (P_2). The lowest Ca% (0.0680) was recorded from P_0 (without priming).



V_0 = ESWYT 5, V_1 = ESWYT 6, V_3 = BARI Gom 28; P_0 = Control (without priming), P_1 = 5 % PEG, P_2 = 2% Mannitol; S_0 = Control (No salt), S_1 = 10 dS m^{-1}, S_2 = 15 dS m^{-1}

Figure 13. Effect of variety, salt stress and priming treatment on Ca% of wheat

4.13.4 Interaction effect of variety and salt stress

Interaction between variety and salt stress was affected significantly on Ca% (Table 9). The highest Ca% (0.0880) was obtained from the interaction treatment of V_1S_0 which was statistically identical with V_1S_1 and V_2S_1. The lowest Ca% (0.0526) was recorded in interaction of V_2S_0 and V_3S_0.

4.13.5 Interaction effect of variety and priming agent

Ca% was significantly influenced by the interaction of varieties and priming treatment (Table 10). The highest Ca% (0.873) of wheat was recorded in the interaction of V_1P_1 which was statistically different from all other treatment .combinations. The lowest Ca% (0.0580) of wheat was recorded in V_3P_0.

4.13.6 Interaction effect of salt stress and priming agent

Ca% was significantly influenced by the interaction of salt stress and priming agent (Table 11). The highest Ca% (0.0886) of wheat was recorded in the interaction of S_0P_1 which was statistically similar with S_1P_1. The lowest Ca% (0.0553) recorded in S_2P_0 and it was statistically similar S_1P_0.

Table 11. Interaction effect of salt stress and priming agent on plant nutrient of Wheat

Treatment	N%	K%	Ca%
S_0P_0	0.0080 ab	0.0300 b	0.0653 de
S_0P_1	0.0170 a	0.0406 a	0.0886 a
S_0P_2	0.0095 ab	0.0313 ab	0.0740 cd
S_1P_0	0.0076 ab	0.0280 b	0.0600 ef
S_1P_1	0.0106 ab	0.0373 ab	0.0873 ab
S_1P_2	0.0094 ab	0.0310 b	0.0713 cd
S_2P_0	0.0061 b	0.0166 c	0.0553 f
S_2P_1	0.0103 ab	0.0346 ab	0.0780 bc
S_2P_2	0.0092 ab	0.0300 b	0.0673 de
CV (%)	**8.44**	**12.7**	**10.34**
LSD $_{(0.05)}$	**0.01**	**0.01**	**0.01**

S_0P_0 = Control (no salt) × Control (no priming); S_0P_1 = Control (no salt) × 5% PEG; S_0P_2 = Control (no salt) × 2% Mannitol; S_1P_0 = 10 dS m^{-1} × Control (no priming); S_1P_1 = 10 dS m^{-1} × 5% PEG; S_1P_2 = 10 dS m^{-1} × 2% Mannitol; S_2P_0 = 15 dS m^{-1} × Control (no priming); S_2P_1 = 15 dS m^{-1} × 5% PEG; S_2P_2 = 15 dS m^{-1} × 2% Mannitol.

4.13.7 Interaction effect of variety, salt stress and priming treatment

Ca% was significantly influenced by the interaction effect of variety, salt stress and priming treatment on wheat (Table 12). The maximum Ca% (0.1180) was recorded in $V_1S_0P_1$. On the other hand, the lowest Ca% (0.0140) was obtained from $V_3S_2P_0$.

Table 12. Interaction effect of variety, salt stress and priming agent on plant nutrient content of wheat

Treatment	N%	K%	Ca%
$V_1S_0P_0$	0.008	0.0300 a-d	0.0620 i-l
$V_1S_0P_1$	0.02	0.0440 a	0.1180 a
$V_1S_0P_2$	0.018	0.0400 ab	0.1080 ab
$V_1S_1P_0$	0.006	0.0268 b-d	0.0608 j-m
$V_1S_1P_1$	0.013	0.0400 ab	0.1000 bc
$V_1S_1P_2$	0.013	0.0400 ab	0.0940 b-d
$V_1S_2P_0$	0.006	0.0200 c-e	0.0480 lm

Table 12 Cont'd

Treatment	N%	K%	Ca%
$V_1S_2P_1$	0.012	0.0360 a-c	0.0820 d-g
$V_1S_2P_2$	0.0083	0.0300 a-d	0.0680 g-k
$V_2S_0P_0$	0.0103	0.0360 a-c	0.0780 d-i
$V_2S_0P_1$	0.018	0.0400 ab	0.1080 ab
$V_2S_0P_2$	0.0103	0.0340 a-d	0.0760 e-j
$V_2S_1P_0$	0.006	0.0240 b-d	0.0580 klm
$V_2S_1P_1$	0.012	0.0380 ab	0.0920 b-e
$V_2S_1P_2$	0.01	0.0320 a-d	0.0720 f-k
$V_2S_2P_0$	0.006	0.0190 de	0.0440 m
$V_2S_2P_1$	0.012	0.0360 a-c	0.0800 d-h
$V_2S_2P_2$	0.008	0.0300 a-d	0.0660 g-k
$V_3S_0P_0$	0.006	0.0280 a-d	0.0620 i-l
$V_3S_0P_1$	0.0103	0.0340 a-d	0.0720 f-k
$V_3S_0P_2$	0.0103	0.0340 a-d	0.0720 f-k
$V_3S_1P_0$	0.006	0.0240 b-d	0.0560 k-m
$V_3S_1P_1$	0.012	0.0360 a-c	0.0880 c-f
$V_3S_1P_2$	0.0096	0.0300 a-d	0.0680 g-k
$V_3S_2P_0$	0.004	0.0040 e	0.0140 n
$V_3S_2P_1$	0.012	0.0360 a-c	0.0780 d-i
$V_3S_2P_2$	0.008	0.0300 a-d	0.0640 h-l
CV (%)	**8.55**	**9.45**	**9.35**
LSD $_{(0.05)}$	**NS**	**0.02**	**0.02**

V_1S_0P0 = ESWYT 5 × Control (no salt) × Control (no priming); $V_1S_0P_1$ = ESWYT 5 × Control (no salt) × 5% PEG; $V_1S_0P_2$ = ESWYT 5 × Control (no salt) × 2% Mannitol; $V_1S_1P_0$ = ESWYT 5 × 10 dS m^{-1} × Control (no priming); $V_1S_1P_1$ = ESWYT 5 × 10 dS m^{-1} × 5% PEG; $V_1S_1P_2$ = ESWYT 5 × 10 dS m^{-1} × 2% Mannitol; $V_1S_2P_0$ = ESWYT 5 × 15 dS m^{-1} × Control (no priming); $V_1S_2P_1$ = ESWYT 5 × 15 dS m^{-1} × 5% PEG; $V_1S_2P_2$ = ESWYT 5 × 15 dS m^{-1} × 2% Mannitol; $V_2S_0P_0$ = ESWYT 6 × Control (no salt) × V_2Control (no priming); $V_2S_0P_1$ = ESWYT 6 × Control; (no salt) × 5% PEG; $V_2S_0P_2$ = ESWYT 6 × Control (no salt) × 2%; Mannitol; $V_2S_1P_0$ = ESWYT 6 × 10 dS m^{-1} × Control (no priming); $V_2S_1P_1$ = ESWYT 6 × 10 dS m^{-1} × 5% PEG; $V_2S_1P_2$ = ESWYT 6 × 10 dS m^{-1} × 2% Mannitol; $V_2S_2P_0$ = ESWYT 6 × 15 dS m^{-1} × Control (no priming); $V_2S_2P_1$ = ESWYT 6 × 15 dS m^{-1} × 5% PEG; $V_2S_2P_2$ = ESWYT 6 × 15 dS m^{-1} × 2% Mannitol; $V_2S_0P_0$= BARI Gom 28 × Control (no salt) × Control (no priming); $V_3S_0P_1$ = BARI Gom 28 × Control (no salt) × 5% PEG; $V_3S_0P_2$ = BARI Gom 28 × Control (no salt) × 2% Mannitol; $V_3S_1P_0$ = BARI Gom 28 × 10 dS m^{-1} × Control (no priming); $V_3S_1P_1$ = BARI Gom 28 × 10 dS m^{-1} × 5% PEG; $V_3S_1P_2$ = BARI Gom 28 × 10 dS m^{-1} × 2% Mannitol; $V_3S_2P_0$ = BARI Gom 28 × 15 dS m^{-1} × Control (no priming); $V_3S_2P_1$ = BARI Gom 28 × 15 dS m^{-1} × 5% PEG; $V_3S_2P_2$ = BARI Gom 28 × 15 dS m^{-1} × 2% Mannitol.

Soil sample analysis

4.14 pH

4.15.1 Effect of variety

The data pertaining to pH of soil presented in Table 13 indicated that effect of variety on pH was observed non-significant.

4.14.2 Effect of salt stress

pH of soil differed significantly due to different salt stress on wheat (Table 13). The maximum pH (7.32) was obtained from 15 dS m^{-1} (S_2) as the application of salt makes soil alkaline. The lowest pH (7.21) was observed in no salt (S_0).

4.14.3 Effect of priming agent

The data pertaining to pH of wheat of soil presented in Table 13 indicated that effect of priming agent on pH was observed non-significant.

Table 13. Effect of variety, salt stress and priming agent on soil of experiment field

Treatment	pH	N%	Fe (ppm)	OC%	P (ppm)	K (meq)	Ca (meq)
V_1	7.28	0.29 a	0.021	0.72 a	6.87 a	1.04 a	37.05
V_2	7.26	0.28 a	0.021	0.69 ab	6.35 b	1.00 b	36.77
V_3	7.24	0.22 b	0.018	0.68 b	5.96 c	0.97 b	34.89
CV (%)	**0.87**	**3.80**	**15.81**	**4.52**	**2.66**	**5.44**	**5.23**
LSD $_{(0.05)}$	**NS**	**0.01**	**NS**	**0.02**	**0.13**	**0.04**	**1.43**
S_0	7.21 c	0.32 a	0.02	0.72 a	7.78 a	1.12 a	37.61
S_1	7.25 b	0.25 b	0.019	0.70 ab	6.75 b	1.05 b	35.89
S_2	7.32 a	0.22 c	0.018	0.68 b	4.66 c	0.85 c	35.22
CV (%)	**0.97**	**3.80**	**50.00**	**6.40**	**6.29**	**5.44**	**2.99**
LSD $_{(0.05)}$	**0.04**	**0.01**	**NS**	**0.03**	**0.24**	**0.03**	**0.64**
P_0	7.25	0.25 b	0.017 b	0.67 b	5.30 c	0.92 c	35.44
P_1	7.26	0.27 a	0.022 a	0.73 a	7.22 a	1.12 a	36.67
P_2	7.26	0.26 a	0.022 a	0.68 b	6.66 b	0.97 b	36.61
CV (%)	**1.24**	**6.13**	**5.46**	**4.73**	**4.48**	**6.39**	**5.75**
LSD $_{(0.05)}$	**NS**	**0.01**	**0.01**	**0.02**	**0.16**	**0.03**	**1.15**

V_0 = ESWYT 5, V_1 = ESWYT 6, V_3 = BARI Gom 28; P_0 = Control (without priming), P_1 = 5 % PEG, P_2 = 2% Mannitol; S_0 = Control (No salt), S_1 = 10 dS m^{-1}**,** S_2 = 15 dS m^{-1}

4.14.4 Interaction effect of variety and salt stress

pH was significantly influenced by the interaction effect of varieties and salt stress (Table 14). The highest value (4.41) was recorded in interaction of V_1S_2 which was statistically differed from all other treatment combinations. On the other hand, the lowest value (7.22) was obtained from V_1S_0.

4.14.5 Interaction effect of variety and priming agent

pH of soil differed significantly due to interaction effect of varieties and priming agent (Table 15). The highest pH (7.33) was recorded with the interaction of V_1P_1 which was significantly similar with a number of treatment combinations, whereas, the lowest value (7.18) was recorded with $V_3P_{0.}$

4.14.6 Interaction effect of salt stress and priming agent

pH of soil differed significantly due to interaction effect of salt stress and priming agent (Table 16). The highest pH value (7.36) was recorded with the interaction of $S_2P_{0,}$ significantly similar with S_2P_1 and S_2P_2 and S_1P_1, whereas, the lowest pH value (7.16) was recorded with $S_0P_{1.}$

4.14.7 Interaction effect of variety, salt stress and priming treatment

pH was significantly influenced by the interaction effect of variety, salt stress and priming treatment are manifested in Table 17. Results indicated that the highest pH value (7.50) was with interaction of $V_1S_2P_{0.}$ On the other hand, the lowest (7.00) result was obtained from $V_1S_0P_1$

4.15 N%

4.15.1 Effect of variety N%

The data regarding the N% of soil (Table 13) indicated that significant influence by different varieties. ESWYT 5 (V_1) significantly showed highest pH which was statistically similar with ESWYT 6 (V_2). The shortest plant was found in BARI Gom 28 (V_3).

4.15.2 Effect of salt stress

N of soil differed significantly due to different salt stress on wheat (Table 13). The maximum N (0.32%) was obtained from no salt (S_0) .The lowest (0.22%) was observed in 15 dS m^{-1} (S_2).

4.15.3 Effect of priming agent

N of soil differed significantly due to different priming agent on soil (Table 13). The maximum N (0.27%) was obtained from 5% PEG (P_1) and it was statistically similar with 2% mannirol (P_2). The lowest (0.25%) was observed in P_0 (without priming).

4.15.4 Interaction effect of variety and salt stress

Interaction between varieties and salt stress was observed significantly positive effect on N (Table 14). The maximum value (0.356%) was observed in interaction treatment of V_1S_0 which was statistically similar with V_2S_0 interactions. The lowest value (0.197%) was noticed in interaction of V_3S_2.

Table 14. Interaction effect of variety and salt stress on soil of experiment field

Treatment	pH	N	Fe	OC%	P	K	Ca
V_1S_0	7.09 e	0.356 a	0.030 a	0.743 a	9.00 a	1.32 a	38.67 a
V_1S_1	7.22 d	0.260 c	0.02 a-c	0.653 de	6.27 d	1.03 c-	36.6 b-d
V_1S_2	. 7.41 a	0.230 d	0.02 a-c	0.69 b-d	5.63 e	0.99 e	36.6 b-d
V_2S_0	7.24 cd	0.347 a	0.017 bc	0.737 ab	8.38 b	1.09 b	37.48 b
V_2S_1	7.26 b-d	0.250 c	0.027 ab	0.71 a-c	6.66 d	1.0 b-d	36.00 cd
V_2S_2	7.33 b	0.217 e	0.02 a-c	0.71 a-c	4.56 f	0.86 f	35.65 de
V_3S_0	7.22 d	0.290 b	0.02 a-c	0.733 ab	7.68 c	1.08 bc	37.00 bc
V_3S_1	7.27 b-d	0.221de	0.013 c	0.683 cd	5.60 e	1.01 de	34.67 e
V_3S_2	7.29 bc	0.197 f	0.013 c	0.613 e	3.81 g	0.60 g	33.33 f
CV (%)	**0.97**	**3.80**	**50.00**	**6.40**	**6.29**	**5.44**	**2.99**
LSD $_{(0.05)}$	**0.07**	**0.01**	**0.01**	**0.05**	**0.41**	**0.06**	**1.11**

V_1S_0 = ESWYT 5 × S_0 = Control (No salt); V_1S_1 = ESWYT 5 × 10dS m^{-1} ; V_1S_2 = ESWYT 5 × 15 dS m^{-1} ; V_2S_0 = ESWYT 6 × S_0 = Control (No salt); V_2S_1 = ESWYT 6 × 10 dS m^{-1} ; V_2S_2 = ESWYT 6 × 15 dS m^{-1}; V_3S_0 = BARI Gom 28 × S_0 = Control (No salt); V_3S_1 = BARI Gom 28 × 10 dS m^{-1} and V_3S_2 = BARI Gom 28 × 15 dS m^{-1} .

4.15.5 Interaction effect of variety and priming agent

Interaction effect of varieties and priming treatment was significantly influence on N (Table 15). Results indicated that the highest N value (0.320%) was with interaction of V_1P_1 and it was significantly different from all other treatment combinations. On the other hand, the lowest (0.250%) result was obtained from $V_3P_{0.}$

4.15.6 Interaction effect of salt stress and priming agent

Interaction effect of salt stress and priming agent was significantly influence on N (Table 16). Results indicated that the highest N value (0.367%) was with interaction of S_0P_1 which was statistically differed from all other combinations. On the other hand, the lowest result was obtained from S_2P_0 (0.237%).

4.15.7 Interaction effect of variety, salt stress and priming treatment

Interaction between variety, salt stress and priming treatment was affected significantly N value (Table 17). The highest N value (8.00%) was obtained from the interaction treatment of $V_1S_0P_1$ and it was statistically similar with $V_2S_0P_1$. The lowest N value (0.190%) was recorded in interaction of $V_3S_2P_{0.}$

4.16 Fe (ppm)

4.16.1 Effect of variety

The data pertaining to Fe of wheat of soil presented in Table 13 indicated that effect of variety on Fe was observed non-significant.

4.16.2 Effect of salt stress

The data pertaining to Fe of wheat of soil presented in Table 13 indicated that effect of salt stress on Fe was observed non-significant.

4.16.3 Effect of priming agent

The data pertaining to Fe of wheat of soil presented in Table 13 indicated that effect of priming agent on Fe was observed significant. The maximum Fe (0.22 ppm) was obtained from 5% PEG (P_1) statistically identical with 2% mannitol (P_2).The lowest (0.17 ppm) was observed in P_0 (without priming).

4.16.4 Interaction effect of variety and salt stress

Interaction between variety and salt stress was affected significantly on Fe (Table 14). The highest Fevalue (0.030 ppm) was obtained from the interaction treatment of V_1S_0 which was statistically similar with all combination except V_2S_0, V_3S_1 and V_3S_2.The lowest Fe value (0.013 ppm) was recorded in interaction of V_3S_2.

4.16.5 Interaction effect of variety and priming agent

Interactions of varieties and priming treatment had a significant influenced on Fe of soil (Table 15). It was observed that V_1P_1 treatment interaction showed the highest Fe (0.027 ppm) of soil having a statistically significant relationship with a number of treatment combinations. However, the lowest Fe value (0.010 ppm) was recorded in V_3P_0 which was statistically similar with V_1P_0 and V_2P_0.

Table 15. Interaction effect of variety and priming on soil of experiment field

Treatment	pH	N%	Fe (ppm)	OC%%	P (ppm)	K (meq)	Ca (meq)
V_1P_0	7.24 bc	0.250 c	0.020 ab	0.667 cd	5.75 e	0.900 d	35.67 b-d
V_1P_1	7.33 a	0.320 a	0.027 a	0.773 a	7.66 a	1.153 a	37.67 a
V_1P_2	7.26 a-c	0.280 b	0.020 ab	0.7167 b	6.97 c	1.080 b	37.00 ab
V_2P_0	7.22 bc	0.207 d	0.017 bc	0.647 d	5.65 e	0.890 d	35.00 cd
V_2P_1	7.29 ab	0.288 b	0.026 a	0.746 ab	7.37 b	1.127 ab	37.33 ab
V_2P_2	7.26 a-c	0.280 b	0.020 ab	0.680 c	6.66 d	0.976 c	36.33 a-c
V_3P_0	7.18 c	0.207 d	0.010 c	0.640 d	4.26 f	0.876 d	34.00 d
V_3P_1	7.29 ab	0.287 b	0.023 ab	0.740 b	7.35 b	1.117 ab	37.15 ab
V_3P_2	7.24 bc	0.250 c	0.020 ab	0.680 c	5.90 e	0.930 cd	35.98 a-d
CV (%)	**2.33**	**7.45**	**4.56**	**4.73**	**5.66**	**6.39**	**7.55**
LSD $_{(0.05)}$	**0.09**	**0.01**	**0.01**	**0.03**	**0.27**	**0.06**	**1.99**

V_1P_0 = ESWYT 5 × Control (no priming); V_1P_1 = ESWYT 5 × 5% PEG; V_1P_2 = ESWYT 5 × 2% Mannitol; V_2P_0 = ESWYT 6 × Control (no priming); V_2P_1 = ESWYT 6 × 5% PEG; V_2P_2 = ESWYT 6 × 2% Mannitol; V_3P_0 = BARI Gom 28 × Control (no priming); V_3P_1 = BARI Gom 28 × 5% PEG and V_3P_2 = BARI Gom 28 × 2% Mannitol.

4.16.6 Interaction effect of salt stress and priming agent

Interactions of salt stress and priming agent had a significant influenced on Fe of soil (Table 16). The maximum Fe value (0.026) was obtained from S_0P_1 which was statistically similar with all combinations except S_2P_0. However, the lowest Fe value (0.010).

4.16.7 Interaction effect of variety, salt stress and priming treatment

Interaction among variety, salt stress and priming treatment was affected significantly on Fe value (Table 17). The highest Fe value (0.040) was obtained from the interaction treatment of $V_1S_2P_1$, $V_2S_2P_2$ and $V_3S_1P_1$.

4.17 OC%

4.17.1 Effect of variety

OC%% was significantly affected by wheat varieties (Table 13). The highest (0.72) was obtained from ESWYT 5 (V_1) followed by ESWYT 6 (V_2). The lowest OC%% was found in BARI Gom 28.

4.17.2 Effect of salt stress

The data the OC%% of soil as affected by different salt stress are presented in Table 13. Result noticed that the OC%% decreased significantly by increase salinity. The maximum OC%% (0.72) was observed in no salt (S_0), statistically similar with 10 dS m^{-1} (S_1). The lowest value of OC%% (0.68) was recorded from 15 dS m^{-1} (S_2).

4.17.3 Effect of priming agent

The data OC%% of soil as affected by different priming agent are presented in Table 13. Result noticed that the OC% increased significantly by priming treatment increase. The maximum OC% (0.73) was observed in 5% PEG (P_1) whereas the lowest (0.67) result was obtained from no priming and it was statistically similar with P_2 (2% mannitol).

4.17.4 Interaction effect of variety and salt stress

Data on OC% are shown in Table 14, which was significantly influenced by interaction effect of varieties and salt stress treatment. Results revealed that the highest OC% (0.743) was observed in V_1S_0. The lowest value for OC% (0.613) was obtained from V_3S_2 which was statistically similar with V_1S_1.

4.17.5 Interaction effect of variety and priming agent

OC% was influenced significantly due to interaction effect of varieties and priming treatment (Table 15). The maximum value (0.773) of OC% was obtained from V_1P_1

which was statistically different from all other combinations except V_2P_1. The lowest OC% value (0.680) was recorded in V_3P_0.

4.17.6 Interaction effect of salt stress and priming agent

OC% was influenced significantly due to interaction effect of salt stress and priming agent (Table 16). It was observed that S_0P_1 (0.796) treatment interaction showed the highest value of OC% of soil which was statistically differed from all other combinations. The lowest OC% value (0.640) was recorded in S_2P_0 which was statistically identical with $S_1P_{0.}$

Table 16. Interaction effect of salt stress and priming on soil nutrient content of experiment field

Treatment	pH	N%	Fe (ppm)	OC%	P (ppm)	K (meq)	Ca (meq)
S_0P_0	7.22 cd	0.237 e	0.020 ab	0.676 d	6.23 e	0.893 de	35.67 cd
S_0P_1	7.16 d	0.367 a	0.026 a	0.796 a	10.08 a	1.390 a	38.82 a
S_0P_2	7.23 bcd	0.273 c	0.023 ab	0.710 bc	6.69 d	1.020 c	36.00 c
S_1P_0	7.17 d	0.194 f	0.017 bc	0.643 e	5.21 f	0.850 e	35.33 cd
S_1P_1	7.31 ab	0.297 b	0.023 ab	0.720 b	7.60 b	1.283 b	38.00 ab
S_1P_2	7.27 bc	0.273 c	0.020 ab	0.706 b-d	6.38 e	0.950 d	36.00 c
S_2P_0	7.36 a	0.180 g	0.010 c	0.640 e	2.083 g	0.706 f	33.98 d
S_2P_1	7.30 ab	0.290 b	0.023 ab	0.713 bc	7.04 c	1.023 c	36.33 bc
S_2P_2	7.29 abc	0.257 d	0.020 ab	0.683 cd	6.26 e	0.933 d	36.00 c
CV (%)	**1.45**	**5.13**	**6.55**	**7.87**	**5.66**	**6.39**	**6.77**
LSD $_{(0.05)}$	**0.09**	**0.01**	**0.01**	**0.03**	**0.27**	**0.06**	**1.99**

S_0P_0 = Control (no salt) × Control (no priming); S_0P_1 = Control (no salt) × 5% PEG; S_0P_2 = Control (no salt) × 2% Mannitol; S_1P_0 = 10 dS m^{-1} × Control (no priming); S_1P_1 = 10 dS m^{-1} × 5% PEG; S_1P_2 = 10 dS m^{-1} × 2% Mannitol; S_2P_0 = 15 dS m^{-1} × Control (no priming); S_2P_1 = 15 dS m^{-1} × 5% PEG; S_2P_2 = 15 dS m^{-1} × 2% Mannitol.

4.17.7 Interaction effect of variety, salt stress and priming treatment

Data on OC% value are shown in Table 17. OC% value was significantly influenced by interaction effect of variety, salt stress and priming treatment. Results revealed that the highest OC% value (0.850) was observed in $V_1S_0P_{1.}$ The lowest OC% value (0.560) was obtained from $V_3S_2P_{0.}$

4.18 P (ppm)

4.19.1 Effect of variety P

P differed significantly due to varieties (Table 13). Significantly highest P (6.87 ppm) was recorded in ESWYT 6 (V_2). The lowest P (5.96 ppm) was obtained from BARI Gom 28 (V_3).

4.18.2 Effect of salt stress P

P affected significantly due to salt stress in wheat (Table 13) Indicating that increasing the salinity level decreased the P significantly over no salt application. The maximum value (7.78 ppm) was recorded in no salt (S_0) and the lowest (4.66 ppm) was observed in 15 dS m^{-1} (S_2).

4.18.3 Effect of priming agent

P affected significantly due to priming agent in soil (Table 13. The maximum value (7.22 ppm) was recorded in 5% PEG ($P_{1)}$ and the lowest (5.30 ppm) was observed in P_0 (without priming).

4.18.4 Interaction effect of variety and salt stress

P was significantly influenced by the interaction effect of variety and salt stress treatment on soil (Table 14). The maximum P value (9.00 ppm) was recorded in V_1S_0 which was statistically different from all other treatment combinations. On the other hand, the lowest value (4.56 ppm) was obtained from $V_3S_{2.}$

4.18.5 Interaction effect of variety and priming agent

P was significantly influenced by the interaction of varieties and priming treatment (Table 15). The highest P value (7.66 ppm) of soil) was recorded in the interaction of V_1P_1 which was statistically different from all other combinations. The lowest P value (4.26 ppm) of wheat was recorded in $V_3P_{0.}$

4.18.6 Interaction effect of salt stress and priming agent

P was significantly influenced by the interaction of salt stress and priming agent (Table 16). The highest P value (10.08 ppm) of soil was recorded in the interaction of S_0P_1 and it was statistically differed from all other combinations. The lowest P value (6.23 ppm) of soil was recorded in S_2P_0.

4.18.7 Interaction effect of variety, salt stress and priming treatment

P was significantly influenced by the interaction effect of variety, salt stress and priming treatment on wheat (Table 17). The maximum P value (13.75 ppm) was recorded in $V_1S_0P_1$. On the other hand, the lowest P value (2.25 ppm) was obtained from $V_3S_2P_0$ having statistically significant relationship with all other treatment combinations.

4.19 K (meq)

4.19.1 Effect of variety

The data pertaining to number of K as influenced by varieties has been presented in the Table 3. Significantly highest K (1.04 meq) was recorded in ESWYT 5 (V_1) and the lowest in BARI Gom 28 (V_3) which was statistically similar with ESWYT 6 (V_2).

4.19.2 Effect of salt stress

P affected significantly due to salt stress in soil (Table 13) iundicating that increasing the salinity level results in decrease of P. The maximum value (1.12 meq) was recorded in no salt (S_0) and the lowest (0.85 meq) was observed in 15 dS m^{-1} (S_2)

4.19.3 Effect of priming agent

P affected significantly due to priming agent in soil (Table 13). The maximum value (1.12 meq) was recorded in 5% PEG (P_1) and the lowest (0.92 meq) was observed in P_0 (without priming).

4.19.4 Interaction effect of variety and salt stress

Data regarding interaction effect of variety and salt stress on K are given in Table 14. K content was significantly influenced by interaction effect of varieties and different salt stress. Results revealed that the highest K value (1.32 meq) was recorded with V_1S_0 which was statistically different from all other treatment combinations. The lowest value (0.86 meq) was obtained from $V_3S_{2.}$

4.19.5 Interaction effect of variety and priming agent

Data regarding interaction effect of variety and priming agent on K are placed in Table 15. K content was significantly influenced by interaction effect of varieties and different priming treatment. Results revealed that the highest K value (1.153 meq) was recorded with V_1P_1 followed by V_1P_1 and V_2P_1. The lowest K value (0.876 v) was obtained from V_3P_0.

4.19.6 Interaction effect of salt stress and priming agent

Data regarding interaction effect of salt stress and priming agent on K value are given in Table 16. K content was significantly influenced by interaction effect of salt stress and priming agent. Results revealed that the highest K value (1.390 meq) was recorded with S_0P_1 which was statistically differed from all other combinations. The lowest K value (0.706 meq) was obtained from $S_2P_{0.}$

4.19.7 Interaction effect of variety, salt stress and priming treatment

Data regarding Interaction effect of variety, salt stress and priming treatment K value are given in Table 17. K content was significantly influenced by interaction effect of variety, salt stress and priming treatment. Results revealed that the highest K value

(1.670 meq) was recorded with $V_1S_0P_1$. The lowest K value (0.510 meq) was obtained from $V_3S_2P_0$.

4.20 Ca (meq)

4.21.1 Effect of variety

The content of Ca was significantly influenced due to different varieties (Table 13). Result revealed that the maximum Ca (37.05 meq) was observed in ESWYT 5 (V_1) which was statistically similar with ESWYT 6 (V_2) and lowest Ca (34.89 meq) was obtained from BARI Gom 28 (V_3).

4.20.2 Effect of salt stress

Ca content of soil differed significantly due to different salt stress (Table 13). The maximum Ca (37.61 meq) was obtained from no salt (S_0) and the lowest (35.22 meq) was observed in 15 dS m^{-1} (S_2)

4.20.3 Effect of priming agent on Ca

Ca of soil differed significantly due to different priming agent (Table 13). The maximum Ca (36.67 meq) was obtained from 5% PEG (P_1) which was statistically identical with 2%Mannitol (P_2). The lowest (35.44 meq) was observed in P_0 (without priming).

4.20.4 Interaction effect of variety and salt stress

Interaction between variety and salt stress was affected significantly on Ca (Table 14). The highest Ca value (38.67 meq) was obtained from the interaction treatment of V_1S_0 which was statistically different from all other treatment combinations. The lowest Ca value (34.67 meq) was recorded in interaction of V_3S_2.

4.20.5 Interaction effect of variety and priming agent

Ca was influenced significantly due to interaction effect of varieties and priming treatment (Table 15). The maximum Ca value (37.67 meq) was obtained from V_1P_1 which was statistically similar with a number of treatment combinations. The lowest Ca value (34.00 meq) was recorded in V_3P_0 which was statistically similar with V_3P_1, V_3P_2 and V_2P_0.

4.20.6 Interaction effect of salt stress and priming agent

Interaction effect of salt stress and priming agent was significantly influence on Ca value (Table 16). Results indicated that the highest Ca value (38.82 meq) was with interaction of S_0P_1 which was statistically similar with S_1P_1. On the other hand, the lowest (36.00 meq) result was obtained from S_2P_0.

4.20.7 Interaction effect of variety, salt stress and priming treatment

Interaction among variety, salt stress and priming treatment was observed significantly positive effect on Ca (Table 17). The maximum Ca value (39.45 meq) was observed in interaction treatment of $V_1S_0P_1$ as compared to other interactions. The lowest Ca value (33.00 meq) was noticed in interaction of $V_3S_2P_0$.

Table 17. Interaction effect of variety, salt stress and priming on soil nutrient content of experiment field

Treatment	pH	N	Fe	OC%	P	K	Ca
$V_1S_0P_0$	7.19 de	0.210 hi	0.010 c	0.670 d	5.66 e	0.880 g-i	35.00 c-e
$V_1S_0P_1$	7.00 f	0.400 a	0.040 a	0.850 a	13.75 a	1.670 a	39.45 a
$V_1S_0P_2$	7.50 e	0.400 a	0.040 a	0.850 a	8.85 b	1.500 b	39.00 ab
$V_1S_1P_0$	7.16 de	0.200 ij	0.010 c	0.670 d	4.55 f	0.790 h-j	34.00 de
$V_1S_1P_1$	7.43 ab	0.380 b	0.040 a	0.780 b	8.70 b	1.300 c	39.00 ab
$V_1S_1P_2$	7.43 ab	0.380 b	0.030 ab	0.780 b	8.55 b	1.280 c	39.00 ab
$V_1S_2P_0$	7.50 a	0.150 k	0.010 c	0.570 e	2.50 h	0.510 k	33.00 e
$V_1S_2P_1$	7.40 a-c	0.320 d	0.030 ab	0.770 b	7.75 c	1.25 c	38.00 a-c
$V_1S_2P_2$	7.20 de	0.240 g	0.020 bc	0.680 d	6.50 d	0.900 fg	36.00 b-e
$V_2S_0P_0$	7.19 de	0.200 ij	0.010 c	0.670 d	5.55 e	0.880 g-i	35.00 c-e
$V_2S_0P_1$	7.30 b-d	0.290 e	0.020 bc	0.700 cd	7.65 c	1.10 de	38.00 a-c
$V_2S_0P_2$	7.30 b-d	0.290 e	0.020 bc	0.700 cd	6.75 d	1.060 e	37.00 a-d
$V_2S_1P_0$	7.11 ef	0.200 ij	0.010 c	0.600 e	4.50 f	0.780 ij	34.00 de
$V_2S_1P_1$	7.43 ab	0.3500 c	0.030 ab	0.780 b	8.50 b	1.280 c	38.00 a-c
$V_2S_1P_2$	7.20 de	0.260 f	0.020 bc	0.690 d	6.65 d	1.000 ef	36.00 b-e
$V_2S_2P_0$	7.10 ef	0.150 k	0.010 c	0.570 e	2.50 h	0.510 k	33.00 e
$V_2S_2P_1$	7.40 a-c	0.320 d	0.030 ab	0.750 bc	7.75 c	1.200 cd	38.00 a-c
$V_2S_2P_2$	7.20 de	0.220 h	0.020 bc	0.680 d	5.75 e	0.890 gh	35.00 c-e
$V_3S_0P_0$	7.17 d-e	0.200 ij	0.010 c	0.670 d	4.55 f	0.880 g-i	34.00 de
$V_3S_0P_1$	7.26 cd	0.260 f	0.020 bc	0.690 d	6.67 d	1.020 e	37.00 a-d
$V_3S_0P_2$	7.26 cd	0.260 f	0.020 bc	0.700 cd	6.67 d	1.020 e	37.00 a-d
$V_3S_1P_0$	7.11 ef	0.190 j	0.010 c	0.600 e	3.50 g	0.770 j	33.95 de
$V_3S_1P_1$	7.40 a-c	0.3200 d	0.030 ab	0.770 b	7.78 c	1.280 c	38.00 a-c
$V_3S_1P_2$	7.20 de	0.250 fg	0.020 bc	0.690 d	6.50 d	0.900fg	36.00 b-e
$V_3S_2P_0$	7.10 ef	0.140 k	0.010 c	0.560 e	1.50 i	0.510 k	33.00 e
$V_3S_2P_1$	7.30 b-d	0.320 d	0.020 bc	0.750 bc	7.70 c	1.100 de	38.00 a-c
$V_3S_2P_2$	7.19 de	0.210 hi	0.010 c	0.680 d	5.75 e	0.89 gh	35.00 c-e
CV (%)	**1.64**	**5.34**	**6.67**	**6.55**	**5.56**	**6.77**	**5.75**
LSD $_{(0.05)}$	**0.15**	**0.02**	**0.02**	**0.05**	**0.47**	**0.10**	**3.45**

V_1S_0P0 = ESWYT 5 × Control (no salt) × Control (no priming); $V_1S_0P_1$ = ESWYT 5 × Control (no salt) × 5% PEG; $V_1S_0P_2$ = ESWYT 5 × Control (no salt) × 2% Mannitol; $V_1S_1P_0$ = ESWYT 5 × 10 dS m^{-1} × Control (no priming); $V_1S_1P_1$ = ESWYT 5 × 10 dS m^{-1} × 5% PEG; $V_1S_1P_2$ = ESWYT 5 × 10 dS m^{-1} × 2% Mannitol; $V_1S_2P_0$ = ESWYT 5 × 15 dS m^{-1} × Control (no priming); $V_1S_2P_1$ = ESWYT 5 × 15 dS m^{-1} × 5% PEG; $V_1S_2P_2$ = ESWYT 5 × 15 dS m^{-1} × 2% Mannitol; $V_2S_0P_0$ = ESWYT 6 × Control (no salt) × V_2Control (no priming); $V_2S_0P_1$ = ESWYT 6 × Control; (no salt) × 5% PEG; $V_2S_0P_2$ = ESWYT 6 × Control (no salt) × 2%; Mannitol; $V_2S_1P_0$ = ESWYT 6 × 10 dS m^{-1} × Control (no priming); $V_2S_1P_1$ = ESWYT 6 × 10 dS m^{-1} × 5% PEG; $V_2S_1P_2$ = ESWYT 6 × 10 dS m^{-1} × 2% Mannitol; $V_2S_2P_0$ =

ESWYT 6 × 15 dS m^{-1} × Control (no priming); $V_2S_2P_1$ = ESWYT 6 × 15 dS m^{-1} × 5% PEG; $V_2S_2P_2$ = ESWYT 6 × 15 dS m^{-1} × 2% Mannitol; $V_2S_0P_0$= BARI Gom 28 × Control (no salt) × Control (no priming); $V_3S_0P_1$ = BARI Gom 28 × Control (no salt) × 5% PEG; $V_3S_0P_2$ = BARI Gom 28 × Control (no salt) × 2% Mannitol; $V_3S_1P_0$ = BARI Gom 28 × 10 dS m^{-1} × Control (no priming); $V_3S_1P_1$ = BARI Gom 28 × 10 dS m^{-1} × 5% PEG; $V_3S_1P_2$ = BARI Gom 28 × 10 dS m^{-1} × 2% Mannitol; $V_3S_2P_0$ = BARI Gom 28 × 15 dS m^{-1} × Control (no priming); $V_3S_2P_1$ = BARI Gom 28 × 15 dS m^{-1} × 5% PEG; $V_3S_2P_2$ = BARI Gom 28 × 15 dS m^{-1} × 2% Mannitol.

SUMMARY AND CONCLUSION

A field experiment entitled "Effects of priming and salt stress on growth, yield and nutrient uptake of wheat genotypes" was carried out under field conditions during the period from November 2017 to June 2018 at the Agronomy field of Sher-e-Bangla Agricultural University, Dhaka -1207. The experiment consisted of three factors viz. (1) Factor A (variety): V_1 (ESWYT 5), V_2 (ESWYT 6) and V_3 (BARI Gom 28); (2) Factor B (salt stress): S_0 (No salt), S_1 (10ds m^{-1}**)** and S_2 (15ds m^{-1}**)** and (3) Factor C: (priming): P_0 (without priming), P_1 (5% PEG) and P_2 (2% Mannitol). PEG and Mannitol were used as priming chemicals and salt (NaCl) was used for salinity stress. The experiment was laid out in a split- split plot design with three factors replicated in three times. There were 27 treatment combinations. The total numbers of unit plots were 81. All the data recorded are subjected to statistical analysis using analytical computer software program statistix-10. The mean differences among the treatments were compared by least significant difference test at 5% level of significance.

The observations were recorded on plant height (cm), number of effective tiller hill^{-1}, number of spike hill^{-1}, spike length (cm), number of filled grain spike^{-1}, weight of 1000 grains (gm), total grain spike^{-1}, grain yield plant^{-1} (gm), straw yield plant^{-1} (gm) harvest index (%), N% (both in plant and soil sample), K%, Ca%, pH, Fe (ppm), OC%, P (ppm), K (meq.), and Ca (meq.).

Seven effects were considered for analyzing data *viz.* effect of variety, effect of salt stress, effect of priming agent, interaction effect of variety and salt stress, interaction effect of variety and priming agent, interaction effect of salt stress and priming agent, interaction effect of variety, salt stress and priming treatment.

The effect of variety on all tested parameters was statistically significant except N%, K%, pH and Fe (ppm). ESWYT 5 (V_1) showed the highest result in respect of all the parameter studied *viz.* plant height (70.46cm), number of effective tiller hill^{-1} (9.27), number of spike hill^{-1} (5.53), spike length (8.70 cm), filled grain spike^{-1} (24.77), total grain spike^{-1} (30.33), grain yield (4.56 t ha^{-1}), straw yield (5.33 t ha^{-1}), weight of 1000 grains (40.58 gm), harvest index (38.45%), N in plant (0.016%), K in plant (0.03335%), Ca in plant (0.0786%), pH (7.28), N in soil (0.29%), Fe (0.021 ppm), OC (0.72 %), P (6.87 ppm), K in plant (1.04 meq) and Ca in plant (37.05 meq). The lowest Plant height (66.64 cm), number of effective tiller hill^{-1} (8.22), number of spike hill^{-1}(4.59), spike length (6.94 cm), filled grain spike^{-1} (21.16), total grain spike^{-1} (26.64), grain yield (3.08 t ha^{-1}), straw yield (4.89 t ha^{-1}), weight of 1000 grains (34.02 gm), harvest index (39.66%), N in plant (0.091%), K in plant (0.0294%), Ca in plant (0.0662%), pH (7.24), N in soil (0.22%), Fe (0.018 ppm), OC (0.68%), P in soil (5.96 ppm), K in soil (0,97 meq) and Ca in soil (34.89 meq) was recorded from V_3 (BARI Gom 28).

In case of the effect of salinity, all the parameters studied were found maximum from no salt (S_0) except pH which was slightly increased with an increase in salinity level. *viz.* plant height (70.46cm), number of effective tiller hill^{-1} (10.28), number of spike hill^{-1}(5.86), spike length (8.41 cm), filled grain spike^{-1} (27.95), total grain spike^{-1} (32.57), grain yield (4.66 t ha^{-1}), straw yield plant^{-1} (5.28 t ha^{-1}), weight of 1000 grains (40.60 gm), harvest index (38.91%), N in plant (0.29%), K in plant (0.0363%), Ca in plant (0.0773%), N in soil (0.32%), Fe (0.02 ppm), Ca in soil (0.0773 meq), OC (0.72%), P (7.78 ppm), K (1.12 meq), Ca (37.61 meq). On the other hand, the lowest plant height (67.37cm), number of effective tiller hill^{-1} (7.54), number of spike hill^{-1}(3.77), spike length (7.14 cm), filled grain spike^{-1} (15.47), total grain spike^{-1} (20.57), grain yield (3.15 t ha^{-1}), straw yield (4.71 t ha^{-1}), weight of 1000 grains (34.41gm), harvest index (41.34%), N in plant (0.077%), K in plant (0.0275%), Ca in plant (0.0668%), N in soil (0.22%), Fe (0.018 ppm), OC (0.68%), P (4.66 ppm), K (0.85 meq) and Ca in soil (35.22 meq) were obtained from S_0. Whereas, the highest and lowest pH value (7.32 and 7.21) was recorded from S_2 and S_0 respectively.

The effect of priming agent on all tested parameters was statistically significant except pH which was found to be non-significant. P_1 (5% PEG) showed the highest result in respect of all the parameter tested in the experiment, e.g., plant height (69.54cm), number of effective tiller hill^{-1} (9.22), number of spike hill^{-1}(5.39), spike length (8.25 cm), filled grain spike^{-1} (24.59), total grain spike^{-1} (29.43), grain yield (4.52 t ha^{-1}), straw yield (6.11 t ha^{-1}), weight of 1000 grains (37.29 gm), harvest index (41.15%), N in plant (0.0119%), K in plant (0.034%), Ca in plant (0.0746%), pH (7.26), N in soil (0.27%), Fe (0.022 ppm), OC (0.73%), P (7.22 ppm), K (1.12 meq), Ca(36.67 meq). On the other hand, control (P_0) showed the lowest result for all the parameters examined, *viz.* plant height (68.44cm), number of effective tiller hill^{-1} (8.06), number of spike hill^{-1}(4.19), spike length (7.22 cm), filled grain spike^{-1} (19.98), total grain spike^{-1} (25.38), grain yield (3.25 t ha^{-1}), straw yield (3.94 t ha^{-1}), weight of 1000 grains (36.59 g), harvest index (41.59%), N in plant (0.0086%), K in plant (0.0252%), Ca in plant (0.0680%), pH (7.25), N in soil (0.25%), Fe (0.017 ppm), OC (0.67%), P (5.30 ppm), K (0.92 meq), Ca(35.44 meq).

In case of the interaction effect of variety and salinity, V_1S_0 was recorded as the supreme performer for all the parameters (except pH) taken into consideration in the experiment, *viz.* plant height (71.61 cm), number of effective tiller hill^{-1} (11.43), number of spike hill^{-1}(6.60), spike length (9.73 cm), filled grain spike^{-1} (31.39), total grain spike^{-1} (34.12), grain yield (5.24 t ha^{-1}), straw yield (6.22 t ha^{-1}), weight of 1000 grains (41.46 gm), harvest index (39.26%), N in plant (0.0143%), K in plant (0.0413%), Ca in plant (0.0880%), N in soil (0.356%), Fe (0.030 ppm), OC (0.743%), P (9.0 ppm), K (1.32 meq), Ca(38.67 meq). Whereas, the lowest plant height (64.85 cm), number of effective tiller hill^{-1} (7.42), number of spike hill^{-1}(3.33), spike length (6.50 cm), filled grain spike^{-1} (11.15), total grain spike^{-1} (16.36), grain yield (2.04 t ha^{-1}), straw yield (4.41 t ha^{-1}), weight of 1000 grains (40.58 gm), harvest index (36.38%), N in plant (0.0067%), K in plant (0.0246%), Ca in plant (0.0526%), N in soil (0.197%), Fe (0.013 ppm), OC (0.613%), P (3.81 ppm), K (0.60 meq), Ca (33.33 meq). On the other hand, the highest and lowest pH value (7.41 and 7.09 respectively) was recorded from V_1S_2 and V_1S_0 respectively.

The interaction effect of variety and priming agent on all tested parameters was reported to be statistically dissimilar. For all the parameters studied in the experiment V_1P_1 showed the highest findings, e.g., plant height (71.65 cm), number of effective tiller hill^{-1} (9.86), number of spike hill^{-1}(6.31), spike length (9.73 cm), filled grain spike^{-1} (18.08), total grain spike^{-1} (23.70), grain yield (5.448 t ha^{-1}), straw yield (6.47 t ha^{-1}), weight of 1000 grains (41.58 gm), harvest index (41.30%), N in plant (0.0126%), K in plant (0.0366%), Ca in plant (0.0873%), pH (7.33), N in soil (0.320%), Fe (0.027 ppm), OC (0.773 %), P (7.66 ppm), K (1.153 meq), Ca(37.67 meq). The lowest plant height (65.93 cm), number of effective tiller hill^{-1} (7.48), number of spike hill^{-1}(3.52), spike length (7.10cm), filled grain spike-^{1} (24.77), total grain spike^{-1} (30.33), grain yield (1.83 t ha^{-1}), straw yield (3.85 t ha^{-1}), weight of 1000 grains (31.45 gm), harvest index (32.18%), N in plant (0.006%), K in plant (0.0206%), Ca in plant (0.0580%), pH (7.18), N in soil (0.207%), Fe (0.010 ppm), OC (0.640%), P (4.26 ppm), K (0.876 meq), Ca (34.00 meq) were obtained from V_3P_0.

In case of salt stress and priming agent interaction, S_0P_1 produced the highest result for all growth, yield and nutrient uptake pattern attributes except pH, i.e., plant height (72.31cm), number of effective tiller hill^{-1} (10.77), number of spike hill^{-1}(6.81), spike length (9.03 cm), filled grain spike^{-1} (30.28), total grain spike^{-1} (35.55), grain yield (5.12 t ha^{-1}), straw yield (6.14 t ha^{-1}), weight of 1000 grains (41.30 gm), harvest index (41.35%), N in plant (0.0170%), K in plant (0.0406%), Ca in plant (0.0886%), N in soil (0.367%), Fe (0.026 ppm), OC (0.796%), P (10.08 ppm), K (1.390 meq), Ca(38.82 meq). The lowest plant height (66.78cm), number of effective tiller hill^{-1} (6.71), number of spike hill^{-1} (3.23), spike length (7.16 cm), filled grain spike^{-1}(14.75), total grain spike^{-1} (19.40), grain yield (2.1 t ha^{-1}), straw yield (3.39 t ha^{-1}), weight of 1000 grains (32.32 gm), harvest index (31.12%), N in plant (0.0061%), K in plant (0.0166%), Ca in plant (0.0553%), N in soil (0.180%), Fe (0.010 ppm), OC (0.640%), P (2.083 ppm), K (0.706 meq), Ca(33.98 meq) were recorded from S_2P_0. However, the highest and lowest pH value (7.36 and 7.16 respectively) was recorded from S_2P_0 and S_0P_1 respectively.

The interaction effect of variety, salt stress and priming treatment combinations for all tested parameters showed statistically significant relationship. $V_1S_0P_1$ showed the highest result for all the parameters studied (followed by $V_1S_0P_2$, $V_1S_1P_1$, $V_1S_1P_2$) except pH, e.g., plant height (75.67cm), number of effective tiller hill^{-1} (11.65), number of spike hill^{-1}(8.00), spike length (11.60 cm), filled grain spike^{-1} (34.10), total grain spike^{-1} (38.79), grain yield (4.88 t ha^{-1}), straw yield (11.80 t ha^{-1}), weight of 1000 grains (42.71 gm), harvest index (41.47%), N in plant (0.02%), K in plant (0.0440%), Ca in plant (0.1180%), N in soil (0.400%), Fe (0.040 ppm), OC (0.850 %), P (13.75 ppm), K (1.670 meq), Ca (39.45 meq). The lowest plant height

(70.46cm), number of effective tiller hill^{-1} (9.27), number of spike hill^{-1}(5.53), spike length (8.70 cm), filled grain spike^{-1} (24.77), total grain spike^{-1} (30.33), grain yield 1.6 t ha^{-1} (3.00 gm), straw yield (3.35 t ha^{-1}), weight of 1000 grains (24.00 gm), harvest index (33.33%), N in plant (0.004%), K in plant (0.0040%), Ca in plant (0.0140%), N in soil (0.140%), Fe (0.010 ppm), OC (0.560%), P (1.50 ppm), K (0.510 meq), Ca(33.00 meq) were recorded from $V_3S_2P_0$. Whereas, the highest and lowest pH value (7.50 and 7.00 respectively) was recorded from $V_1S_2P_0$ and $V_1S_0P_1$ respectively.

From the above discussion it can be concluded that ESWYT 5 (V_1), no salt (S_0) and P_1 (5% PEG), V_1S_0, V_1P_1, S_0P_1 and $V_1S_0P_1$ (followed by $V_1S_0P_2$) were found to give best performances regarding growth, yield and nutrient uptake pattern attributes of wheat.

Recommendations:

To reach a specific conclusion and recommendations, more research work regarding the issue on wheat should be done in different salt affected areas of Bangladesh.

REFERENCES

Akbarimoghaddam, H., Galavi, M., Ghanbari, A. and Panjehkeh, N. (2011). Salinity effects on seed germination and seedling growth of bread wheat cultivars. *Trakia J. sci.* **9**(1): 43 – 50.

Akram, M., Hussain, M., Akhtar, S. and Rasul, E. (2002). Impact of NaCl salinity on yield components of some wheat accessions varieties. *Intl. J. Agric. Biol.* **4**(1): 156-158.

Al-Musa, M.A. A., Ullah, M.A., Moniruzzaman, M., Islam, M.S. and Mukherjee, A. (2012). Effect of BARI wheat varieties on seed germination, growth and yield under Patuakhali district. *J. Environ. Sci. Nat. Res.* **5**(2): 209 -212.

Asgari, H.R., Asgari, H.R., Cornelis, W. and Van Damme, P. (2001). Reclamation of saline-sodic soils by chemical methods. M.Sc. Thesis, Department of Watershed and Arid Zones Management, GorganUniversity of Agricultural Science and Natural Resources (in Persian). p. 90-91.

Ashraf, M. and Foolad, M.R. (2005). Pre-sowing seed treatment—a shotgun approach to improve germination, plant growth, and crop yield under saline and non-saline conditions. *Adv. Agron*. **88(**5**)**:223-271.

Barma, N.C.D., Saifuzzaman, M., Hossain, A.B.S., Rahman, M.M., Saha, N.K. and Rawson, H.M. (2011). Breeding wheat for heat and salt tolerance in southern Bangladesh. *Acta. Tech. Rep. Ser.* **78**: 170-182.

Barrett-lennard, E.G. (1988). Wheat grown on saline water logged soil. *J. Agril.* **5**(1): 175-181.

BBS (Bangladesh Bureau of Statistics) *(*2017). Annual Survey Report. Bangladesh Bureau of Statistics. Statistics Division. Government of the Peoples Republic of Bangladesh. Dhaka. 37.

Bouaouina, S., Zid, E., Hajji, M. and Royo, C. (2000). Tolerance to salinity, ion transport and chlorophyll fluorescence in durum wheat (*Triticum turgidum* L.). Proceedings of seminar, Zaragoza, Spain, 12-14 April, 2000. 40: 239243.

CIMMYT (International Maize and Wheat Improvement center). (2018). WHEAT: CGIAR Research Program (CRP) led by CIMMYT. [http://wheat.org/who-we-are/about-us].

Datta, J.K., Nag, S., Banerjee, A. and Mondal, N.K. (2009). Impact of salt stress on five varieties of Wheat (Triticumaestivum L.) cultivars under laboratory condition. *J. App. Sci. Environ.* **13**(3): 93-97.

Del-Zoppo M.,L. Galleschi, A. Onnis, A. Pardossi and F. Saviozzi. (1999). Effect of salinity on water relations, sodium accumulation, chlorophyll content and proteolytic enzymes in wild Wheat. *Biol. Plant.* **8**: 97-104.

Dhanda, S.S., Sethi, and Behl, R.K. (2004). Indices of drought tolerance in wheat genotypes a G.S. t early stages of plant growth. *J. of Agron. Crop Sci.* **190**(1): 6-12.

El-Hendawy, S.E., Hu-Yuncai and Schmidhalter, U. (2011). Assessing the suitability of various physiological traits to screen wheat. *Int. Integ. Plant Biol.* **49**(9): 1352-1360.

El-Keblawy, A. and Al-Rawai, A. (2006). Effects of seed maturation time and dry storage on light and temperature requirements during germination in invasive *Proso pisjuli* flora. *Flora*. **201**(2): 135-143.

FAO (Food and Agriculture Organization). (2010). Statistical Year Book. MO. UN, Italy, Rome. Pp. 1-280.

FAO (Food and Agriculture Organization). (2016). Statistical Year Book. MO. UN, Italy, Rome. 1-289.

Farooq, M., Basra, S.M.A. and Khan M.B. (2007). Seed priming improves growth of nursery seedling and yield of transplanted rice. *Arch. Agron. Soil Sci*. **53**: 311-322.

Flagella, Z., Vittozzi, L. C., Platini, C. and Fonzo, N. D. (2000). Effect of salt stress on photosynthetic electron transport and grain yield in durum wheat (*Triticum durum*). Papers presented at a conference on irrigation research: Process in the use of water resources, Bari, Italy, 1-2 October 2000. **47**(1): 31-36.

Flowers, T.J. (2004). Improving crop salt tolerance. *J. Exp. Bot.* **55**(396): 307–319.

Ghassemi-Golezani, K., Chadordooz-Jeddi, A., Nasrollahzadeh, S. and Moghaddam, M. (2010). Effects of hydro-priming duration on seedling vigour and grain yield of pinto bean (*Phaseolus vulgaris* L.) cultivars. *Nat. Bot. Hort. Agrobot. Cluj-Napoca*. **38**(1): 109-113.

Hameed, A., Naseer, S., Iqbal, T., Syed, H. and Haq, M.A. (2009). Effects of NaCl salinity on seedling growth, Senescence, catalase and protease activities in two wheat genotypes differing in salt tolerance. *Pakistan. J. Bot.* **40**(3): 1043-1051.

Hopkins, W.G. and Huner, N.P.A. (2004). Introduction to Plant Physiology. Third Edition. John Wiley and Sons, Inc. USA.

Husain, S., R. Munns and Condon. A.G. (2003). Effect of Sodium exclusion trait on chlorophyll retention and growth of durum wheat in saline soil. *Australian J. Agril. Res.* **54**(6): 589-597.

Iqbal, M. and Ashraf, M. (2005). Pre-sowing seed treatment with cytokinin and its effect on growth, photosynthetic rate, ionic levels and yield of two wheat cultivars differing in salt tolerance. *J. Integrative Plant Biol.* **47**: 1315-1325.

Islam, M.R. and Salam, M.A. (1996). Growth and yield performance of some selected rice lines under different salinity regimes. *Bangladesh J. Train. Dev.* **9**(2): 53-56.

Kahrizi, S., Sedghi, M. and Sofalian, O. (2013). Evaluation of the effect of salt stress on some of agronomic and morphological characters in ten durum wheat cultivars. *Biology*. **16**(1):1924.

Kalhoro, N.A., Rajpar, I., Kalhoro, S.A., Ali, A., Raza, S., Ahmed, M., Kalhoro, F.A., Ramzan, M. and Wahid, F. (2016) Effect of Salts Stress on the Growth and Yield of Wheat (*Triticum aestivum* L.). *American J. Plant Sci.* **7**: 227-234.

Kaur, S., Gupta, A.K. and Kaur, N. (2005). Seed priming increases crop yield possibly by modulating enzymes of sucrose metabolism in chickpea. *J. Agron. Crop Sci.* **191**: 81-87.

Khan, A.A. (1992). Pre-plant physiological seed conditioning. **In**: Horticultural Reviews. J. Janick, (ed). John Wiley and Sons. New York. pp. 131-81.

Khatun, S., Rizzo, C.A. and Flowers, T.J. (1995). Genotypic variation in the effect of salinity on fertility in rice. *Plant soil*. **173**: 239 – 250.

Kumar, P.M., Chaurasia, A.K. and Michael Bara, B.M. (2017). Effect of osmo-priming on seed germination behaviour and vigour of chickpea (*Cicer arietinum* L.). *Int. J. Sci. Nat.* **8**(2): 330-335.

Laghari, G.M., Laghari, M.R. Soomro, A.A., Leghari, S.J., Solangi, M. and Soomro, A. (2016). Response of mungbean to different hydro-priming periods and temperature regimes. *Sci. Inter.* **28**(2): 1269-1273.

Lauchli, A. and Epstein, E. (1990). Plant responses to saline and sodic conditions. In Tanji KK (ed.), Agricultural salinity assessment and management. ASCE manuals and reports on engineering practice **71**: 113 – 137.

Lauchli, A. and Grattan, S.R. (2007). Plant growth and development under salinity stress. In Jenks MA, Hasegawa PM, Jain SM (Eds), Advances in molecular breeding toward drought tolerance crops. Pp.1 – 32.

Mohammand, A.S., Riai, S. and Niazi, B. (1995). Performance of some wheat germplasm under the ion effect wider saline conditions. *Sarhad J. Agril*. **11**(3): 341-348.

Moud, A.M. and Maghsoudi, K. (2008). Salt stress effects on respiration and growth of germinated seeds of different wheat (*Triticum aestivum* L.) cultivars. *World. J. Agril. Sci.* **4**(3): 351-358.

Munns, R. (2005). Genes and salt tolerance: Bringing them together. *New Phytol*. **167**: 645 – 663.

Naseer, S., Nisar, A. and Ashraf, M. (2001). Effect of salt stress on germination and seedling growth of barley (*Hordeum vulgare* L.). *Pakistan J. Biol. Sci.* **4** (3): 359 – 360.

Noaman, M.M. (2000). Evaluation of some, recombinant line of *Triticum lurgidum* L. for salt tolerance. *J. Arid Environ*. **46**(3): 239-247.

Petersen, L. and Shireen, S. (2001). Soil and water salinity in the coastal area of Bangladesh. *Bangladesh J. Agril*. *Res*. **32**(3): 50-57.

Podmore, C. (2009). Irrigation Salinity – Causes and impacts. Prime fact 937.

Priyadarsini, J. (2001). Yield and quality of rice as affected by varieties and nitrogen source. M.Sc.(Ag) thesis submitted to Acharya N G Ranga Agricultural University, Hyderabad, India.

Rahman, M., Soomro, U.A., Zahoor-ul-Haq, M. and Gul, S. (2008). Effect of NaCl salinity on wheat (*Triticum aestivum* L.) cultivars. *W. J. of Agril. Sci.* **4** (3): 398 – 403.

Rahman, A. M., Barma, C. D., Sarker, M.H., Sarker, M.R. And Nazrul, M.M.I. (2013). *Bangladesh J. Agril*. *Res*. **38**(1): 97-104.

Rahman, S.M., Khalil, M.I. and Acih, A.C. (1989). Nuclear techniques to improve crop production in salt-affected soils. Workshop on the evaluation of the Res. Activities under PL-480 programme (Title-3) for 1987-88. BINA, Mymensingh, Bangladesh.

Rajpar, I. and Sial, N.B. (2002). Effect of salinity and sodicity with and without soil conditioner (polyerylamide) on the seedling emergencies and growth of different wheat varieties. *Pakistan J. Appl. Sci.* **2**(6): 631-636.

Rouhi, H.R., Aboutalebian, M.A. and Sharif-Zadeh, F. (2011). Effects of hydro and osmopriming on drought stress tolerance during germination in four grass species. *Int. J. Agric. Sci.* **1**: 701-774.

Shirazi, M.U., Asif, S.M., Khanzada, B., Khan, M.A., Ali, M., Mumtaj, S., Yousufazai, M. N. and Saif, M. S. (2012). Growth ion accumulation in some wheat genotypes under NaCl stress. *Pakistan J. Biol. Sci*. **4**: 388-91.

Sholi, N.J.Y. (2012). Effect of salt stress on seed germination, plant growth, photosynthesis and ion accumulation of four tomato cultivars. *American J. Plant Physiol.* **7**(6): 269 – 275.

Singh, A. K., Prakash, V. and Sastry, E. V. D. (2000). Effect of salinity stress on seed germination and seeding growth of wheat. *Agric. Sci. Digest*. **20**(2): 96-98.

Sun, Y.Y., Sun,Y.J., Wang, M.T., Li,X.Y., Guo, X. Hu, R. and Jun, M.A. (2010). Effects of seed priming on germination and seedling growth under water stress in rice. *Acta. Agron. Sin.* **36**(11): 1931-1940.

Talebian, M.A., Sharifzadeh, F., Jahansouz, M.R., Ahmadi, A. and Naghavi, M.R. (2008). Evaluation the effect of seed priming on germination, seedling stand and grain yield of wheat cultivars (*Triticum aestivum* L.) in three different regions in Iran. *Iran J. Crop Sci.* **39**(1): 145-154.

Tammam, A.A; Abou, M.F.; Alhamd and Hemeda, M.M. (2008). Study of salt tolerance in wheat (*Triticum aestium* L.) cultivar Banysoif-1. *Agric. J. Crop Sci.* **1**(3): 115-125.

Toklu, F., Baloch, F., Karaköy, T. and Ozkan, H. (2015). Effects of different priming applications on seed germination and some agromorphological characteristics of bread wheat (*Triticum aestivum* L.). *Turkish J. of Agric. and Forest.* **39**(6), 1005-1013.

Turki, N., Harrabi, M. and Okuno, K. (2012). Effect of salinity on grain yield and quality of wheat and genetic relationships among durum and common wheat. *J. Arid Land Studies.* **22**(1): 311 -314.

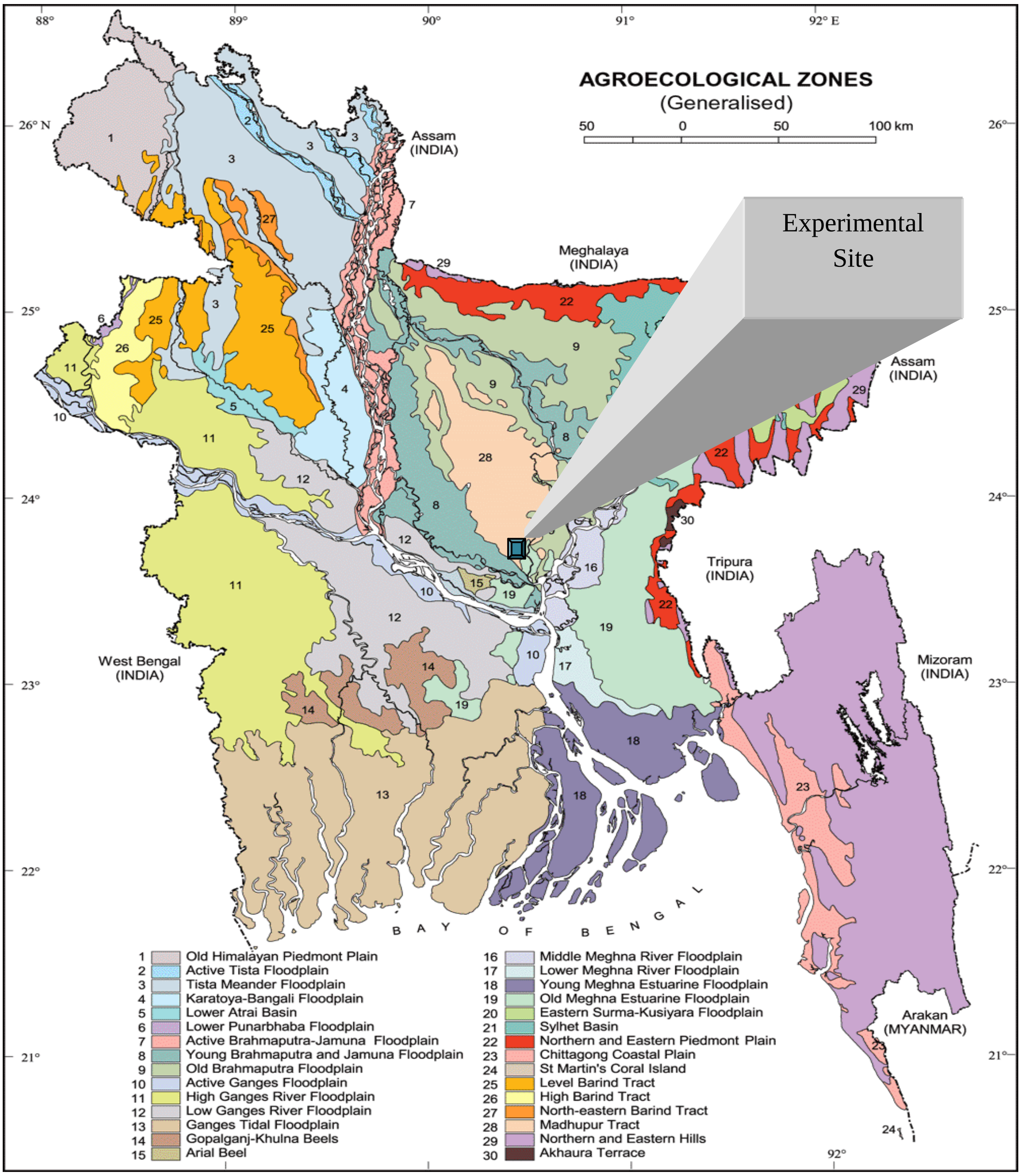
Wahid, A., Perveen, M., Gelani, S. and Basra, S.M.A. (2007). Pretreatment of seed with H_2O_2 improves salt tolerance of wheat seedlings by alleviation of oxidative damage and expression of stress proteins. *J. Plant Physiol.* **164**: 283-294.

Wang, B., Z. Li, A.E., Eneji, X., Tian, Z., Zhai, J., Li and L. Duan. (2008). Effects of coronatine on growth, gas exchange traits, chlorophyll content, antioxidant enzymes and lipid peroxidation in maize (*Zea mays* L.) seedlings under simulated drought stress. *Plant Prod. Sci.* **11**: 283-290.

Yoshida, S. (1981). Fundamentals of rice crop science. International Rice Research Institute. Los Banos. Philippines. 269.

Zheng, G.H., Wilen, R.W., Slinkard, A. E. and Gusta, L.V. (2013). Enhancement of canola seed germination and seedling emergence at low temperature by priming. *Crop Sci.* **34**: 1589-1593.

APPENDICES



Appendix I. Map showing the experimental site under the study

Appendix II: Monthly records of air temperature, relative humidity and rainfall during the period from November 2017 to June 2018

Month	RH (%)	Air temperature (^{0}C)			Rainfall (mm)
		Max.	Min.	Mean	
November	65	32.0	19.0	26.0	35
December	74	29	15	22	15
January	68	26	10	18	7
February	57	15	24	25.42	25
March	57	34	16	28	65

(Source: time and date.com)

Appendix III: Characteristics of experimental soil analyzed at Soil Resources Development Institute (SRDI), Farmgate, Dhaka

A. Morphological characteristics of the experimental field

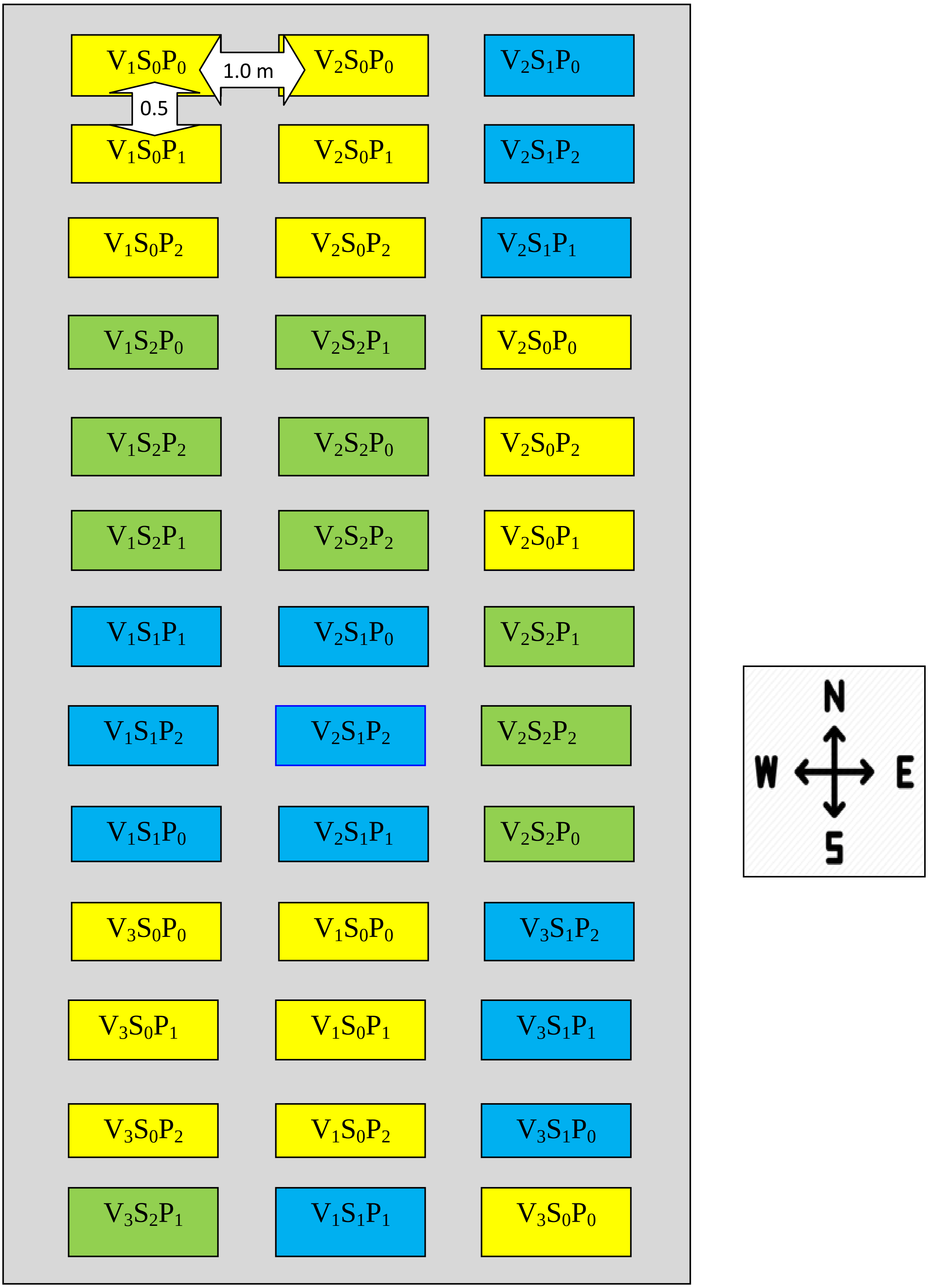
Morphological features	Characteristics
Location	Horticulture Farm, SAU, Dhaka
AEZ	Modhupur Tract (28)
General Soil Type	Shallow red brown terrace soil
Land type	High land
Soil series	Tejgaon
Topography	Fairly leveled
Flood level	Above flood level
Drainage	Well drained
Cropping pattern	Not Applicable

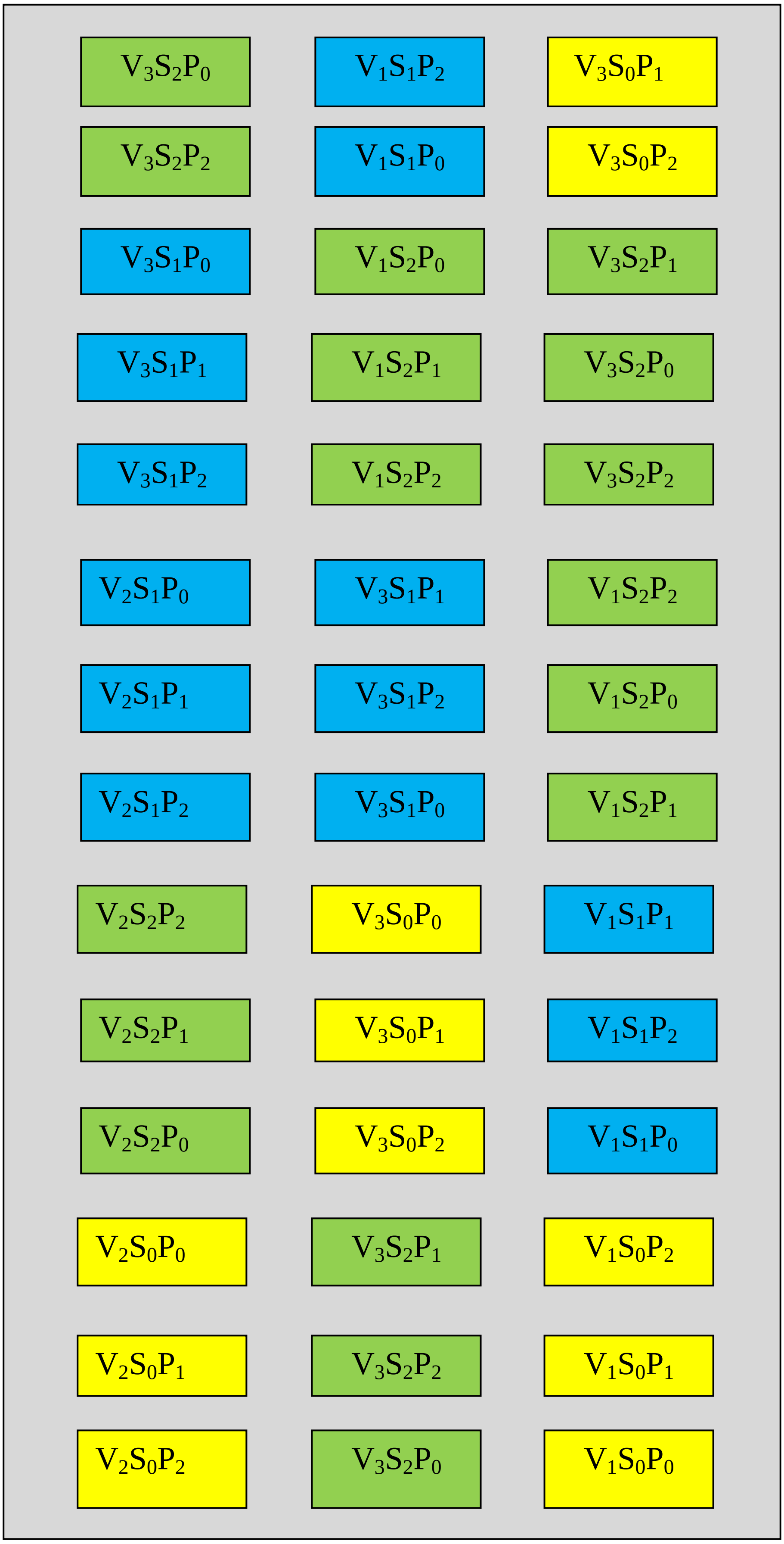
Source: Soil Resource Development Institute (SRDI)

B. Physical and chemical properties of initial soil

Characteristics	Value
Partical size analysis % Sand	27
% Silt	43
% Clay	30
Textural class	Silty Clay Loam (ISSS)
pH	5.6
Organic carbon (%)	0.45
Organic matter (%)	0.78
Total N (%)	0.03
Available P (ppm)	20
Exchangeable K (me/100 g soil)	0.1
Available S (ppm)	45

Appendix IV: Layout of the experiment

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$V_3S_0P_1$
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$V_2S_0P_2$
$V_3S_2P_0$
$V_1S_0P_0$

Appendix V: Analysis of variance of plant height (cm)

Source	DF	SS	MS	F	P
Replication (A)	**2**	**369.26**	**184.628**		
Variety (B)	2	223.49	111.744	4.71	0.0889
Error AxB	4	94.91	23.727		
Salt (C)	2	167.29	83.643	3.67	0.0570
BxC	4	21.69	5.423	0.24	0.9114
Error AxBxC	12	273.29	22.774		
Priming (D)	2	17.61	8.806	1.26	0.2958
BxD	4	29.68	7.421	1.06	0.3894
CxD	4	128.90	32.226	4.61	0.0041
BxCxD	8	69.86	8.732	1.25	0.2999
Error AxBxCxD	36	251.58	6.988		
Total	80	1647.55			

Appendix VI: Analysis of variance effective tillers hill^{-1}

Source	DF	SS	MS	F	P
Replication (A)	2	24.262	12.1310		
Variety (B)	2	15.449	7.7246	6.90	0.0505
Error AxB	4	4.476	1.1191		
Salt (C)	2	103.008	51.5039	106.13	0.0000
BxC	4	13.603	3.4008	7.01	0.0038
Error AxBxC	12	5.823	0.4853		
Priming (D)	2	22.028	11.0140	19.34	0.0000
BxD	4	3.471	0.8677	1.52	0.2159
CxD	4	1.024	0.2561	0.45	0.7719
BxCxD	8	12.661	1.5826	2.78	0.0167
Error AxBxCxD	36	20.499	0.5694		
Total	80	226.304			

Appendix VII: Analysis of variance of spike hill^{-1}

Source	DF	SS	MS	F	P
Replication (A)	2	17.346	8.6731		
Variety (B)	2	13.592	6.7958	9.13	0.0323
Error AxB	4	2.978	0.7446		
Salt (C)	2	61.917	30.9585	60.30	0.0000
BxC	4	8.508	2.1270	4.14	0.0246
Error AxBxC	12	6.161	0.5134		
CxD	4	6.043	1.5108	5.70	0.0012

Appendix VII Cont'd

Source	DF	SS	MS	F	P
Priming (D)	2	24.099	12.0496	45.50	0.0000
BxD	4	5.907	1.4766	5.58	0.0013
BxCxD	8	26.210	3.2762	12.37	0.0000
Error AxBxCxD	36	9.534	0.2648		
Total	80	182.294			

Appendix VIII: Analysis of variance of spike length (cm)

Source	DF	SS	MS	F	P
Replication (A)	2	18.737	9.3687		
Variety (B)	2	45.206	22.6030	53.04	0.0013
Error AxB	4	1.705	0.4262		
Salt (C)	2	23.358	11.6790	26.86	0.0000
BxC	4	16.832	4.2080	9.68	0.0010
Error AxBxC	12	5.218	0.4348		
Priming (D)	2	15.061	7.5303	16.33	0.0000
BxD	4	13.879	3.4698	7.52	0.0002
CxD	4	21.635	5.4088	11.73	0.0000
BxCxD	8	25.595	3.1993	6.94	0.0000
Error AxBxCxD	36	16.600	0.4611		
Total	80	203.826			

Appendix IX: Analysis of variance of filled grain spike^{-1}

Source	DF	SS	MS	F	P
Replication (A)	2	94.27	47.14		
Variety (B)	2	177.67	88.84	48.08	0.0016
Error AxB	4	7.39	1.85		
Salt (C)	2	2311.15	1155.58	261.60	0.0000
BxC	4	1025.51	256.38	58.04	0.0000
Error AxBxC	12	53.01	4.42		
Priming (D)	2	338.32	169.16	49.21	0.0000
BxD	4	37.53	9.38	2.73	0.0441
CxD	4	99.96	24.99	7.27	0.0002
BxCxD	8	63.70	7.96	2.32	0.0406
Error AxBxCxD	36	123.74	3.44		
Total	80	4332.25			

Appendix X: Analysis of variance of total grain spike^{-1}

Source	DF	SS	MS	F	P
Error AxB	4	8.08	2.02		
Salt (C)	2	2279.82	1139.91	279.08	0.0000
BxC	4	889.01	222.25	54.41	0.0000
Error AxBxC	12	49.01	4.08		
Priming (D)	2	280.32	140.16	38.90	0.0000
BxD	4	29.23	7.31	2.03	0.1112
CxD	4	89.56	22.39	6.21	0.0007
BxCxD	8	118.56	14.82	4.11	0.0015
Error AxBxCxD	36	129.72	3.60		
Total	80	4176.28			

Appendix XI: Analysis of variance of grain yield (t ha^{-1})

Source	DF	SS	MS	F	P
Replication (A)	2	13.178	6.5891		
Variety (B)	2	22.682	11.3410	79.90	0.0006
Error AxB	4	0.568	0.1419		
Salt (C)	2	21.480	10.7401	86.17	0.0000
BxC	4	24.145	6.0363	48.43	0.0000
Error AxBxC	12	1.496	0.1246		
Priming (D)	2	15.735	7.8673	37.20	0.0000
BxD	4	14.739	3.6847	17.42	0.0000
CxD	4	45.451	11.3628	53.72	0.0000
BxCxD	8	23.539	2.9423	13.91	0.0000
Error AxBxCxD	36	7.614	0.2115		
Total	80	190.627			

Appendix XII: Analysis of variance of straw yield (t ha^{-1})

Source	DF	SS	MS	F	P
Replication (A)	2	11.478	5.7390		
Variety (B)	2	3.074	1.5370	2.70	0.1809
Error AxB	4	2.275	0.5688		
Salt (C)	2	4.873	2.4363	25.88	0.0000
BxC	4	2.922	0.7305	7.76	0.0025
Error AxBxC	12	1.130	0.0941		
Prime (D)	2	63.573	31.7866	161.78	0.0000
BxD	4	0.843	0.2109	1.07	0.3841
CxD	4	3.500	0.8749	4.45	0.0050
BxCxD	8	6.510	0.8138	4.14	0.0014

Appendix XII Cont'd

Source	DF	SS	MS	F	P
Error AxBxCxD	36	7.073	0.1965		
Total	80	107.251			

Appendix XIII: Analysis of variance of 1000 grain weight (gm)

Source	DF	SS	MS	F	P
Replication (A)	2	137.33	68.667		
Variety (B)	2	591.03	295.513	57.76	0.0011
Error AxB	4	20.46	5.116		
Salt (C)	2	518.42	259.211	65.12	0.0000
BxC	4	425.36	106.340	26.71	0.0000
Error AxBxC	12	47.77	3.981		
Priming (D)	2	65.42	32.710	7.29	0.0022
BxD	4	81.01	20.253	4.51	0.0047
CxD	4	39.43	9.859	2.20	0.0888
BxCxD	8	73.62	9.202	2.05	0.0677
Error AxBxCxD	36	161.51	4.486		
Total	80	2161.37			

Appendix XIV: Analysis of variance of harvest Index (%)

Source	DF	SS	MS	F	P
Replication (A)	2	156.96	78.481		
Variety (B)	2	11.08	5.541	4.83	0.0859
Error AxB	4	4.59	1.148		
Salt (C)	2	64.63	32.314	23.58	0.0001
BxC	4	20.58	5.144	3.75	0.0333
Error AxBxC	12	16.44	1.370		
Prime (D)	2	793.92	396.959	76.01	0.0000
BxD	4	25.16	6.289	1.20	0.3258
CxD	4	94.03	23.508	4.50	0.0047
BxCxD	8	38.55	4.819	0.92	0.5095
Error AxBxCxD	36	188.00	5.222		
Total	80	1413.94			

Appendix XV: Analysis of variance of N% (in plant)

Source	DF	SS	MS	F	P
Replication (A)	2	1.390	6.952		
Variety (B)	2	2.596	1.298	15.18	0.0136
Error AxB	4	3.420	8.551		
Salt (C)	2	7.622	3.811	2.96	0.0900
BxC	4	2.911	7.278	5.66	0.0085
Error AxBxC	12	1.544	1.286		
Priming (D)	2	2.02	1.011	2.59	0.0890
BxD	4	1.751	4.378	11.21	0.0000
CxD	4	6.644	1.661	4.25	0.0064
BxCxD	8	2.022	2.528	6.47	0.0000
Error AxBxCxD	36	1.406	3.906		
Total	80	1.420			

Appendix XVI: Analysis of variance of K% (in plant)

Source	DF	SS	MS	F	P
Replication (A)	2	5.240	2.620		
Variety (B)	2	1.969	9.846	1.69	0.2936
Error AxB	4	2.329	5.823		
Salt (C)	2	5.749	2.874	9.07	0.0040
BxC	4	1.256	3.141	9.91	0.0009
Error AxBxC	12	3.804	3.170		
Priming (D)	2	1.006	5.032	1.53	0.2306
BxD	4	5.147	1.287	3.91	0.0098
CxD	4	7.680	1.920	5.83	0.0010
BxCxD	8	3.750	4.688	14.24	0.0000
Error AxBxCxD	36	1.185	3.292		
Total	80	9.013			

Appendix XVII: Analysis of variance of Ca% (in plant)

Source	DF	SS	MS	F	P
Replication (A)	2	0.00005	2.472		
Variety (B)	2	0.00016	8.004	1.14	0.4047
Error AxB	4	0.00028	6.998		
Salt (C)	2	0.00868	4.342	112.50	0.0000
BxC	4	0.00778	1.946	50.42	0.0000
Error AxBxC	12	0.00046	3.860		

Appendix XVII Cont'd

Source	DF	SS	MS	F	P
Priming (D)	2	0.00008	3.893	0.18	0.8329
BxD	4	0.00507	1.267	5.98	0.0009
CxD	4	0.00345	8.634	4.07	0.0080
BxCxD	8	0.00865	1.081	5.10	0.0003
Error AxBxCxD	36	0.00763	2.119		
Total	80	0.04230			

Appendix XVIII: Analysis of variance of pH

Source	DF	SS	MS	F	P
Replication (A)	2	0.00072	0.00036		
Variety (B)	2	0.02162	0.01081	2.90	0.1667
Error AxB	4	0.01492	0.00373		
Salt (C)	2	0.15776	0.07888	16.39	0.0004
BxC	4	0.37091	0.09273	19.27	0.0000
Error AxBxC	12	0.05776	0.00481		
Priming (D)	2	0.00496	0.00248	0.31	0.7353
BxD	4	0.11171	0.02793	3.50	0.0164
CxD	4	0.15858	0.03964	4.96	0.0027
BxCxD	8	0.60396	0.07549	9.45	0.0000
Error AxBxCxD	36	0.28761	0.00799		
Total	80	1.79049			

Appendix XIX: Analysis of variance of N%

Source	DF	SS	MS	F	P
Replication (A)	2	0.00084	0.00042		
Variety (B)	2	0.07109	0.03554	11.94	0.0206
Error AxB	4	0.01191	0.00298		
Salt (C)	2	0.14329	0.07164	35.00	0.0000
BxC	4	0.02111	0.00528	2.58	0.0913
Error AxBxC	12	0.02456	0.00205		
Priming (D)	2	0.00949	0.00474	2.57	0.0903
BxD	4	0.02411	0.00603	3.27	0.0219
CxD	4	0.07491	0.01873	10.16	0.0000
BxCxD	8	0.13409	0.01676	9.09	0.0000
Error AxBxCxD	36	0.06638	0.00184		
Total	80	0.58178			

Appendix XX: Analysis of variance of Fe (ppm)

Source	DF	SS	MS	F	P
Replication (A)	2	5.543	2.771		
Variety (B)	2	8.889	4.444	1.03	0.4351
Error AxB	4	1.723	4.307		
Salt (C)	2	1.556	7.778	2.92	0.0927
BxC	4	2.044	5.111	19.18	0.0000
Error AxBxC	12	3.198	2.665		
Priming (D)	2	5.556	2.778	9.22	0.0006
CxD	4	9.778	2.444	8.11	0.0001
BxD	4	1.244	3.111	10.32	0.0000
BxCxD	8	3.022	3.778	12.53	0.0000
Error AxBxCxD	36	1.085	3.014		
Total	80	9.672			

Appendix XXI: Analysis of variance of OC%

Source	DF	SS	MS	F	P
Replication (A)	2	0.00341	0.00170		
Variety (B)	2	0.01820	0.00910	10.26	0.0266
Error AxB	4	0.00355	0.00089		
Salt (C)	2	0.01727	0.00863	2.89	0.0945
BxC	4	0.09733	0.02433	8.15	0.0020
Error AxBxC	12	0.03585	0.00299		
Priming (D)	2	0.05087	0.02543	11.96	0.0001
BxD	4	0.09093	0.02273	10.69	0.0000
CxD	4	0.09107	0.02277	10.70	0.0000
BxCxD	8	0.10673	0.01334	6.27	0.0000
Error AxBxCxD	36	0.07658	0.00213		
Total	80	0.59178			

Appendix XXII: Analysis of variance of P (ppm)

Source	DF	SS	MS	F	P
Replication (A)	2	6.658	3.3290		
Variety (B)	2	6.481	3.2405	1.27	0.3749
Error AxB	4	10.235	2.5587		
Salt (C)	2	6.978	3.4892	1.20	0.3337
BxC	4	232.056	58.0139	20.02	0.0000
Error AxBxC	12	34.765	2.8971		

Appendix XXII Cont'd

Source	DF	SS	MS	F	P
Priming (D)	2	24.304	12.1521	5.03	0.0119
BxD	4	51.273	12.8184	5.30	0.0018
CxD	4	46.609	11.6523	4.82	0.0032
BxCxD	8	113.892	14.2365	5.89	0.0001
Error AxBxCxD	36	87.053	2.4181		
Total	80	620.305			

Appendix XXIII: Analysis of variance of K (meq)

Source	DF	SS	MS	F	P
Replication (A)	2	0.10339	0.05169		
Variety (B)	2	0.50407	0.25203	316.01	0.0000
Error AxB	4	0.00319	0.00080		
Salt (C)	2	0.29340	0.14670	7.45	0.0079
BxC	4	1.86113	0.46528	23.63	0.0000
Error AxBxC	12	0.23624	0.01969		
Priming (D)	2	0.09447	0.04723	1.57	0.2221
BxD	4	0.51747	0.12937	4.30	0.0060
CxD	4	0.62393	0.15598	5.18	0.0021
BxCxD	8	2.41533	0.30192	10.03	0.0000
Error AxBxCxD	36	1.08342	0.03009		
Total	80	7.73604			

Appendix XXIV: Analysis of variance of Ca (meq)

Source	DF	SS	MS	F	P
Replication (A)	2	0.289	0.1445		
Variety (B)	2	20.667	10.3333	9.03	0.0329
Error AxB	4	4.576	1.1440		
Salt (C)	2	20.667	10.3333	7.76	0.0069
BxC	4	190.667	47.6667	35.79	0.0000
Error AxBxC	12	15.983	1.3319		
Priming (D)	2	18.000	9.0000	5.55	0.0079
BxD	4	13.333	3.3333	2.06	0.1070
CxD	4	5.333	1.3333	0.82	0.5194
BxCxD	8	57.333	7.1667	4.42	0.0009
Error AxBxCxD	36	58.353	1.6209		
Total	80	405.201			