# POTENCIES OF SOME SELECTED VEGETABLES IN BANGLADESH AS BIO-HERBICIDE

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# POTENCIES OF SOME SELECTED VEGETABLES IN BANGLADESH AS BIO-HERBICIDE

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# CERTIFICATE

This is to certify that the thesis entitled, **"POTENCIES OF SOME SELECTED VEGETABLES IN BANGLADESH AS BIO-HERBICIDE"** submitted to the Department of Agricultural Chemistry, Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE IN AGRICULTURAL CHEMISTRY,** embodies the result of a piece of bona fide research work carried out by **MD. KABIRUL ISLAM** bearing **Registration No. 09-03660** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

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

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# POTENCIES OF SOME SELECTED VEGETABLES IN BANGLADESH AS BIO-HERBICIDE

## ABSTRACT

An experiment was conducted during the period of December 2016 to August 2017 at the Laboratory of the Agricultural Chemistry and net house of Sher-e-Bangla Agricultural University Dhaka-1207, Bangladesh to evaluate the potencies of some selected vegetables in Bangladesh as bio-herbicide. Treatment as six levels of aqueous solution of ten vegetables (potato, tomato, radish, bottle gourd, sweet potato, danta, cauliflower, cabbage, common bean, helencha) i.e. $P_1$=0 ppm, $P_2$= 1 ppm, $P_3$= 2 ppm, $P_4$= 3 ppm, $P_5$= 4 ppm and $P_6$= 5 ppm were considered. Result indicated that the lowest values of germination percentage, shoot length, root length and dry weight of two test species were in treatment $P_6$ and highest in $P_1$ treatment. Thus, ten selected vegetables in Bangladesh could be used to control associated crops. Therefore, these vegetables used in this study could be candidates for isolation and identify of phytotoxins to serve as weed inhibiting agents for sustainable crop production.

## Some commonly used Abbreviations

| Full word | Abbreviations |
|---|---|
| Carbon Dioxide | $CO_2$ |
| Electrical Conductivity | EC |
| And Others | *et al.* |
| Centimeter | cm |
| Milligram | mg |

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# CHAPTER I

# INTRODUCTION

Phytotoxicity is defined as a delay of seed germination, inhibition of plant growth or any adverse effect on plants caused by specific substances (phytotoxins) or growing conditions. Such damage may be caused by a wide variety of compounds, including trace metals, salinity, pesticides, phytotoxins or allelochemicals. Phytotoxicity is described as the beneficial and deleterious biochemical interaction between plants and micro-organisms. It is a direct or indirect effect caused by one plant, including micro-organisms, on another through the production of chemical compounds that escape into the environment and competition which involves the removal of some factors (nutrient, water and light) from the environment, habitat or through chemicals released from one plant (donor) that affect the other (receiver) sharing the habitat. The phenomenon known as "allelopathy" is now considered as important as competition for influencing plant growth both in natural and agricultural ecosystem. It is a biological phenomenon by which an organism produces one or more chemicals that influence the growth, survival and reproduction of nearby species. Allelopathy is a process involving secondary plant metabolites that negatively influence the growth and development of other plants (Rice, 1984). Chemicals that bring about the phenomenon of allelopathy are known as allelochemicals and are involved in practically every aspect of plant growth acting from stimulants to suppressants (Singh *et al*., 2001). In modern sustainable agricultural system, the use of these allelochemicals is being encouraged to utilize this untapped resource for weed control thereby reducing the concerns of ecological, environmental and health problems associated with synthetic pesticides (Singh *et al*., 2003). Natural plant products with biological activity are the ideal leads for new chemical

structures useful in the development of molecules with potential utilization in agronomy. The phytotoxic action of various natural compounds on the growth and development of many plants may be inhibitory or stimulatory depending on their concentrations in the surrounding medium and on their physiological activity within plants. This inhibits seed germination by blocking hydrolysis of nutrients reserve and cell division (Irshad and Cheema, 2004), and cause significant reductions in the growth of plume and radical of various crops. Einhellig (1995) mentioned that phytotoxicity may be selective in their action or plants may be selective in their responses. It is once released, are short lived in the environment and therefore, do not disastrously upset the balance as the chemicals would do (Einhellig, 2004). Einhellig (1987) stated that the allelochemical helped to suppress the neighbor plants.

During the past 30 years, the potential impact of allelopathy on the agriculture have been identified, described and discussed in details (Putnam and Duke, 1974, 1978; Rice, 1984; Putnam and Weston 1986; Weston, 1996, Qasem and Foy, 2001; Singh *et al*., 2001). Putnam and Duke (1974) first explored the possibility of utilizing allelopathic crops to suppress weed growth in agricultural sites, including the development of weed-suppressive crops, and later described rotational crops, intercrops, or cover crops for effective weed sup- pression (Putnam and Duke, 1978). Recently, many investigations into the use of cover crops and their residues for weed suppression have been published: some with positive results leading to enhanced weed suppression and reduced herbicide inputs, and others with mixed results, showing yield reductions in crops following a weed suppressive cover (Barnes and Putnam, 1983, 1987; Burgos *et al*., 1999; Einhellig and Rasmussen, 1989; Masiunas *et al*., 1995; Moyer *et al*., 2000; Mwaja *et al*., 1995; Petersen *et al*., 2001; Sene *et al*., 2001;

Shilling *et al*., 1985; Weston, 1996; Weston *et al*., 1989). In particular, the cultivar and species employed, the amount of biomass generated, field conditions at the time of establishment of the cash crop, soil type, and location all impact the ability of the cover crop residue to suppress weeds over time. Although the physical presence of the cover crop residue on the soil surface contributes to a weed-suppressive "mulch" effect, the chemical effect of phytotoxins released from decomposing residues also impacts weed control selectively (Burgos and Talbert, 2000; Nagabushana *et al*., 2001; Putnam,1988; Weston, 1996). Certain weeds, particularly small-seeded annuals, have a tendency to be more highly suppressed in limited tillage systems with decomposing cover crop residues. Many small-seeded annual species are sensitive to the presence of simple and complex phenolics released over time from these residues (Blum, 1998; Blum and Shafer, 1988). This sensitivity more about which cultivars to utilize as cover crops or green manures, and consider time and density of planting, we can more effectively and selectively manage weeds early in the subsequent growing season, following establishment of the cash crop. Transplanting vegetable crops into killed residues has been one way in which use of cover crop residues can work successfully. Another technique is to utilize a living, low-growing suppressive mulch on the soil surface to prevent erosion and suppress weeds effectively in orchards, vineyards, and other perennial crops. Fine leaf fescues, and mixtures of forbs and grasses often are selected in these settings for their ability to suppress weeds and their low maintenance requirements. They are also often stress tolerant as well (Bertin *et al*., 2003).

Under the appropriate environment condition the allelopathic effect may occur to kill the associate plants (Weston, 1996). Allelopathic influence on germination, yield and yield components of sorghum (Hassan *et al*., 2012).

Anjum *et al*. (2010) showed that *Albizia lebbeck and Broussonetia papyrifera* have strong inhibitory effect on radical and hypocotyl growth of lettuce. Successful attempts and utilization of allelopathy influenced in weed management in agroecosystems (Weston, 1996). A recent result indicates that the successfully weed can control in wheat field through sorghum allelochemicals (Cheema, 1988).

Therefore, to best our knowledge the phytotoxic effects of those selected vegetables not yet been done. Thus, the present experiment was conducted to find out the following objectives.

**Objectives**:

Although, a number of pharmacological activities of these vegetables have investigated, but no information about phytotoxicity of those vegetables are recorded. Therefore, the study carried out the following objectives:

1. To investigate the phytotoxic effects of ten selected vegetables on some crops.

# CHAPTER II

# REVIEW OF LITERATURE

Allelopathic interactions in soil environments depend greatly on the turn-over rate of allelochemicals in the soil rhizosphere and their interaction with clay, organic matter, and other factors that change the physicochemical and biotic characteristics of the soil (Blum,1995; Blum and Shafer, 1988). Recent research by Blum and his laboratory associates have shown that soil texture, soil pH, organic carbon, and available nitrogen are important in influencing uptake and of allelochemicals and their ability to persist in the presence of soil microorganisms (Blum, 1995). Soil moisture dynamics can also influence the phytotoxicity of allelochemicals. In recent studies by Blum, data suggested that enhanced evapotranspiration and lower soil moisture will also result in decreased plant phytotoxicity of allelochemicals in the soil solution (Blum, 2002).

Unfortunately, traditional breeding methods have not generally been employed to produce highly allelopathic crops with good yield potential (Duke *et al*., 2002). Recent discussion of the use of genetic engineering to enhance allelopathic traits indicates that this is not a simple task due to the multigenic nature of allelochemical biosynthesis. Nonetheless, the benefits in monetary and time-savings by reductions in hand labor or herbicide application could be extensive if incorporation of enhanced allelopathic or

weed suppressive ability was successful in major agronomic crops (Duke *et al*., 2001, 2002; Scheffler *et al.*, 2001). Genes involved in production of allelochemicals are now being elucidated (Scheffler *et al*., 2001; Yang *et al*., 2004) using a variety of molecular techniques.

In recent research reported by Bertholdsson (2004), early vigor and allelopathic characteristics were often associated with older land races of barley and wheat that are now under evaluation again for development of organically- produced cereal grains. His studies have shown that weed suppressive characteristics are less often associated with newly developed cereal cultivars associated with high yield potential. Older cultivars that establish quickly and have these allelopathic characteristics can suppress weeds effectively over the course of the growing season, which is an important trait when one produces cereals organically (Bertholdsson, 2004). A reexamination of older germplasm may actually assist today's breeders in developing crops that are inherently more weed suppressive, as the tendency towards reduced herbicide usage continues.

In the allelopathy community's plants will interact either positively or negatively. However, it is more common that neighboring plants will interact in a negative manner, whereby the emergence and growth of one or more engaged in the interaction, is inhibited. This adverse effect of a neighboring plant in an association is termed interference (Muller, 1969;

Foy and Inderjit, 2001). Plant interference is generally explained by two phenomena, resource competition and allelopathy. Competition implies limitation of resources such as light, water, space, and nutrients, and allelopathy can be defined as all effects of plants on neighboring plants through the release of chemical compounds into the environment (Rice, 1984).

In nature, it is particularly difficult to separate allelopathic interference from resource competition because there are many factors interacting simultaneously (Weston and Duke, 2003). Proof of allelopathy involves isolating compounds and demonstrating that a toxic effect on other plant species is the main function of the compound and that when the other interactions such as resource limitations are alleviated, the allelopathic effect persists (Williamson, 1990). Under controlled conditions, factors in competition may be separated, and it is possible to prove that chemical interactions are either totally or partially responsible for the interference observed. In devising laboratory and greenhouse studies, efforts have been made to assure that the biological activities obtained are indeed due to the extracellular toxins by the donor plants (Qasem and Foy, 2001). For example, Belz *et al*. (2009) conducted a study to investigate whether or not the plant metabolite parthenin is sufficiently persistent, phytotoxic, and bioavailable in soils to cause an allelopathic effect that makes it

attributable to the invasive success of the weed *P. hysterophorus*. In this study, parthenin was found to be quickly degraded without any evident accumulation to toxic levels over time and therefore; the hypothesis that parthenin contributes to the invasiveness of *P. hysterophorus* was rejected.

Allelopathy has been suggested as a mechanism for the success of invasive plants by establishing a virtual monoculture and may contribute to the ability of particular exotic species to become dominant in invaded plant communities (Hierro and Callaway, 2003). It is expected to be an important mechanism in the plant invasion process because the lack of co-evolved tolerance of resistant vegetation to chemicals produced by the invader, which allows the newly arrived species to dominate natural plant communities.

Allelochemicals cause germination and growth inhibition, and influence a wide variety of metabolic processes. These substances can be isolated from plant tissues. Allelochemicals can be found in numerous parts of a plant such as roots, rhizomes, leaves, stems, pollen, seed, and flowers, and are usually products of secondary plant metabolism (Rice, 1984).

The most important allelochemicals include alkaloids, terpenoids, flavonoids, steroids, tannins, and phenolic compounds (Whittaker and Feeny, 1971; Mandava, 1985; Shaukat *et al*., 2003). Phenolic compounds are reported to constitute the principal allelopathic agents in

weeds and other allelopathic plants. Often their function in the plant is unknown but some allelochemicals are reported to have structural functions e.g., as intermediates of lignification or play a role in general defense against pathogens (Niemeyer, 1988; Corcuera, 1993; Einhellig, 1995). Allelochemicals are released into the environment by root exudation, leaching from aboveground parts, and volatilization and/or by decomposition of plant material (Rice, 1984), and their ability to persist in soil is determined by sorption, fixation, leaching and chemical or microbial degradation (Inderjit, 1998). The degree of phytotoxicity depends on residue persistence and the extent of dissipation in the soil environment.

According to Inderjit and Weiner (2001) allelochemical effects in the field could be due to four possibilities: (i) direct harmful effects of chemicals released from donor plants, (ii) degraded or transformed products of released chemicals, (iii) effect of released chemicals on physical, chemical and biological soil factors, and (iv) induction of release of biologically active chemicals by a third species. Since it is difficult to distinguish between these four possibilities, Inderjit and Weiner (2001) proposed that allelopathy be understood in its ecological context rather that based on direct plant-plant allelopathic interference.

Allelopathy is strongly coupled with other stresses of the crop environment including insect and disease, temperature extremes, light, nutrients and

moisture variables, and herbicides, and is strongly influenced by habitat ecology (Inderjit and Keating, 1999).

Environmental factors also have the ability to influence the production of allelochemicals and their effects. Plants growing in resource-limited environments exhibit higher tissue concentration of secondary compounds when compared to those growing under less stressful conditions. For example, Koeppe *et al*. (1976) found that increased amounts of allelopathic substances were produced when plants grew in phosphorus-deficient soil.

Drought has been reported to have ability to increase the amount of allelopathic compounds in soil (Gershenzon, 1984). It has been shown that allelopathic activities are more pronounced when plant species grow underwater stress (Einhellig, 1987,1989). Ardi (1986) found that the reduction of sweet corn *(Zea mays)* yield due to purple nutsedge *(Cyperus rotundus)* was most severe when the greatest water stress was imposed. Thus, growth inhibition of sweet corn may be due to the combined stress of direct water deficit and greater production of allelopathic substances in purple nutsedge under these conditions.

Chemicals released by plants including allelochemicals also play an important role in influencing ecological processes in plant communities through their effects on soil ecology (Wardle *et al*., 1998). Many secondary metabolites such as phenolics and terpenoids are known to form complexes

with organic ions and influence accumulation of nutrients. Phenolics may affect phosphate availability by competing for anion absorption sites. They can bind to Al, Fe, and Mn, thus releasing phosphate otherwise bound to these cations (Appel, 1993).

Allelochemicals may also influence microbial ecology by their effects on soil microbes and plant pathogens. Population densities of soil-borne microorganisms are affected by soil enrichment with phenolic acids, ferullic, p-coumaric, and vanillic acids (Blum and Shafer, 1988).

However, microbial degradation of allelochemicals may prevent them from reaching phytotoxic levels in natural soils (Schmidt and Ley, 1999). Soil is a very complex system and it affects both the quantitative and qualitative ability of allelochemicals and therefore allelopathic responses of the plant (Inderjit *et al*., 1999). Inderjit and Weiner (2001) suggested that research on the influence of allelochemicals on different components of the soil ecosystem and their role in shaping community structure and composition is needed.

The study of allelopathy therefore has numerous aspects or dimensions, namely: ecology, plant physiology, microbiology, molecular biology, natural product chemistry and agriculture. Its application to agricultural production has been anticipated and researchers have found allelopathic plants that are now used as cover crops for sources of allelochemicals, and

these compounds are serving as leads in the development of new herbicides (Hirai, 2003).

Weeds account for more than 1% of the total plant species on earth, but cause great damage by interfering with food production, health, economic stability and welfare (Qasem and Foy, 2001). They may be defined as plants with little economic value and possessing the potential to colonize disturbed habitats or those modified by human activities (Macias *et al*., 2004). Simply put, weeds are often plants that are uniquely adapted to a wide range of environmental conditions, and they did not acquire problem status until humans developed agriculture. Therefore, it is up to humans to find a solution to the problems weeds cause in agriculture.

Various researchers have referred to allelopathic agents as the future natural pesticides or nature‘s herbicides in action (Putnam, 1983; Rice, 1995). Qasem and Foy (2001), state that the limited work on mode of action of allelochemicals suggests that they affect a variety of sites and biochemical processes, many of which are familiar to those affected by synthetic herbicides. Allelochemicals are considered safer than synthetic chemicals because of their biodegradability.

Allelopathic crops, when used as cover crops, mulch, green manures, or grown in rotation, are helpful in reducing noxious weeds and plant pathogens (Khanh *et al*., 2005). Common examples of crops exhibiting

allelopathy include, *Sorghum bicolor* (Putnam, 1983), *Triticum aestivum* (Kimber, 1973), *Oryza sativa* (Chou, 1995) and *Zea mays* (Yakle and Cruse, 1984).

Crop rotation is reported to have a greater effect on weed species and densities than tillage practices (Weston, 1996), and the practice simultaneously controls pests, enhances ecosystem diversity and improves crop productivity (Mamolos and Kalburtji, 2001). Japanese farmers use beans in spring, buckwheat in summer and then wheat in winter (Kahn *et al*., 2005). The beans are reported to help with soil nutrient enrichment, whilst buckwheat is known as a weed ―killer‖ and can be used as green manure that contributes to soil nutrients. Therefore, buckwheat plants are incorporated in the soil to help reduce weeds and increase the yield of wheat.

Microorganisms can be considered as a source of new allelochemicals; hence their phytotoxic and pharmacologic properties have created growing interest (Macias *et al*., 2004). According to Khalid *et al*. (2002), microbially produced phytotoxins have more potential than some herbicides, because they are selective and, compared to using the actual pathogens, they are easy to formulate, less likely to spread diseases to non-target species, and their activity is less dependent on environmental conditions. This comparison may hold true for certain microbial toxins and

synthetic herbicides, but mostly the latter are more selective in terms of controlling weeds without harming the crop, and they have better residual activity than most herbicides of biological origin.

Allelopathy, as a science, is rapidly growing and its significant role in nature is now fairly well acknowledged. However, more experimental evidence and a great deal of more intensive, precise investigation is still required (Qasem and Foy, 2001). With modern analytical technical methods (HPLC, GC-MS, IR, NMR, etc.), more allelochemicals are likely to be isolated to produce bioactive herbicides and pesticides (Khan *et al*., 2005).

# CHAPTER III

# MATERIALS AND METHODS

The experiment was conducted during the period from December 2016 to August, 2017 to study the "potencies of some selected vegetables in Bangladesh as bio-herbicide". The materials and methods describe a short description of the experimental site, experimental materials, treatments and design, data collection procedure and data analysis. The detailed materials and methods that were used to conduct the study are presented below under the following headings:

## 3.1 Description of the experimental site

### 3.1.1 Location

The experiment was conducted at the Agricultural Chemistry Laboratory and net house, Department of Agricultural Chemistry, Sher-e-Bangla Agricultural University (SAU), Sher-e-Bangla Nagar, Dhaka-1207. It was located in $23^0$41' N latitude and $90^0$22' E longitude at a height of 8.6 m above the sea level.

### 3.1.2 Conditions of net house

The temperature and relative humidity of the net house were recorded during the study period in the SAU weather station. The average minimum and maximum temperature during the study periods of the net house was 15.4 $^{0}$C to 38.20 $^{0}$C, respectively and average minimum and maximum relative humidity was 30.3% and 80.20%, respectively.

## 3.2 Test crops

Two test species i.e. kolmi shak and cucumber were used for this experiment. These seeds were collected from Bangladesh Agricultural Research Institute (BARI). The collected seed species were free from any visible defects, disease symptoms and insect infestations and transported to the laboratory of the Department of Agricultural Chemistry, SAU, Dhaka with careful handling to avoid disease and injury.

## 3.3 Experimental materials

Earthen pots, Petri dish, filter paper, forceps, oven etc. were used for this study. Polythene was used to cover the earthen pots to protect from heavy rain.

### 3.4 Solution Preparation

A number of vegetable leaves samples (potato, tomato, radish, bottle gourd, sweet potato, danta, cauliflower, cabbage, common bean, helencha) were collected from various places at SAU horticultural farm in Bangladesh. The samples were washed in tap water and air-dried. Then the samples were dried in an oven for few days until constant weight was gained. The samples were then grinded to make fine uniform texture and stored in glass jars until use.

#### *A. Aqueous solution preparation*

The samples were extracted in aqueous solution for 48 hours. The extract was then filtered through one layer of filter paper. The residue was re-extracted with equal amount of water for 72 hours. Then residue was filtered by two filtrates combined together.

### 3.5 Phytotoxic assessment

An extract was evaporated to dryness, dissolved in water and added to the petri dish and pot were used. The final assay concentration was placed in net house required to assess phytotoxins.

### 3.6 Treatments

The experiment was conducted under 6 levels of aqueous solution of 10 selected vegetables. There are

1. $P_1$= 0 ppm
2. $P_2$= 1 ppm
3. $P_3$= 2 ppm
4. $P_4$= 3 ppm
5. $P_5$= 4 ppm
6. $P_6$= 5 ppm

### 3.7 Data collection

The following data was collected

a. Germination percentage
b. Shoot length
c. Root length
d. Dry weight

### 3.8 Data collection procedure

#### 3.8.1 Total germination (TG%)

The standard germination test was performed by placing randomly selected 20 seeds in the earthen pots. Experimental units were arranged in a completely randomized design with three replications. Germination was considered to have occurred when radicles were 2 mm long (Akbari *et al.,* 2007). Germination progress was inspected and data were collected at every 24 hr intervals and continued up to 8 days. The seedlings with short, thick and spiral formed hypocotyls and stunted primary root were considered as abnormally germinated seeds (ISTA, 2003). These types of abnormal or dead seedlings were excluded during counting. At the end of germination test (8 days), 6 seedlings from each of the treatments were selected randomly and roots and shoots were cut from the cotyledons and were transferred to brown paper. Then these seedlings were dried in an oven at 75°C for 48 hours.

Total germination (TG) was calculated as the number of seeds which was germinated within total days as a proportion of number of seeds shown in each treatment expressed as a percentage (Othman *et al.,* 2006).

$$\text{TG (\%)} = \frac{\text{Number of germinated seed}}{\text{Total number of seed set for germination}} \times 100$$

### 3.8.2 Shoot length and root length

Randomly selected seedlings from each treatment were collected and cotyledons were removed from them. Shoot and root length were measured with a ruler and accuracy of measurement was 1 mm.

### 3.8.3 Shoot dry weight and root dry weight

The dried radicles and shoots were weighted to the milligram (mg) and converted to milligram. The mean radicle and shoot dry weight were determined with an electric balance. Then it was converted to total dry weight.

## 3.9 Statistical analysis

The data obtained for different parameters were statistically analyzed to observe the significant difference among the treatments. The mean value of all the parameters was calculated and analysis of variance was performed. The significance of difference among the treatments means was estimated by the using Tukey's test at 5% level of significance. A computer software Statistic 10 was used to carry out the statistical analysis.

# CHAPTER 4

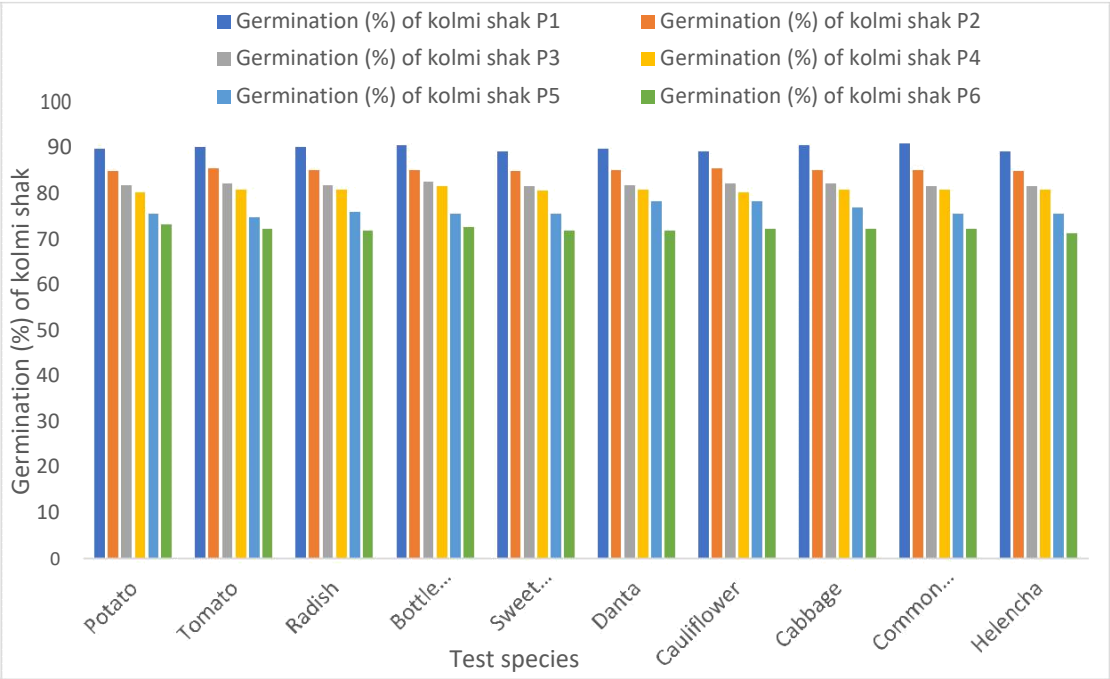
# RESULTS AND DISCUSSIONS

This chapter comprises results and discussions obtained from the experiment potencies of some selected vegetables in Bangladesh as bio-herbicide for weed control cv. kolmi shak and cucumber. The results of the germination and growth parameters of kolmi shak and cucumber as influenced by different concentrations of aqueous solution have been presented and discussed in this chapter.

## 4.1 Effect of aqueous solution on kolmi shak

### 4.1.1 Germination (%)

A positive reduction inhibition effect of germination percentage of kolmi shak was observed. With the increasing the extract solution concentration the decreasing trend of germination (%) was found (Figure 1 and appendix I, II, III, IV, V). The lowest value of germination percentage was recorded from $P_6$ and highest in $P_1$. This might be due to the presence of phytotoxic substances in those selected vegetables. The lowest germination was found in sweet potato and cauliflower in $P_1$ treatment but in case of $P_6$ lowest was recorded in helencha and highest in potato.




$P_1$= 0 ppm, $P_2$= 1 ppm, $P_3$= 2 ppm, $P_4$= 3 ppm, $P_5$= 4 ppm, $P_6$= 5 ppm.

**Figure 1. Effect of aqueous solution of ten vegetables on germination (%) of kolmi shak**

### 4.1.2 Shoot length

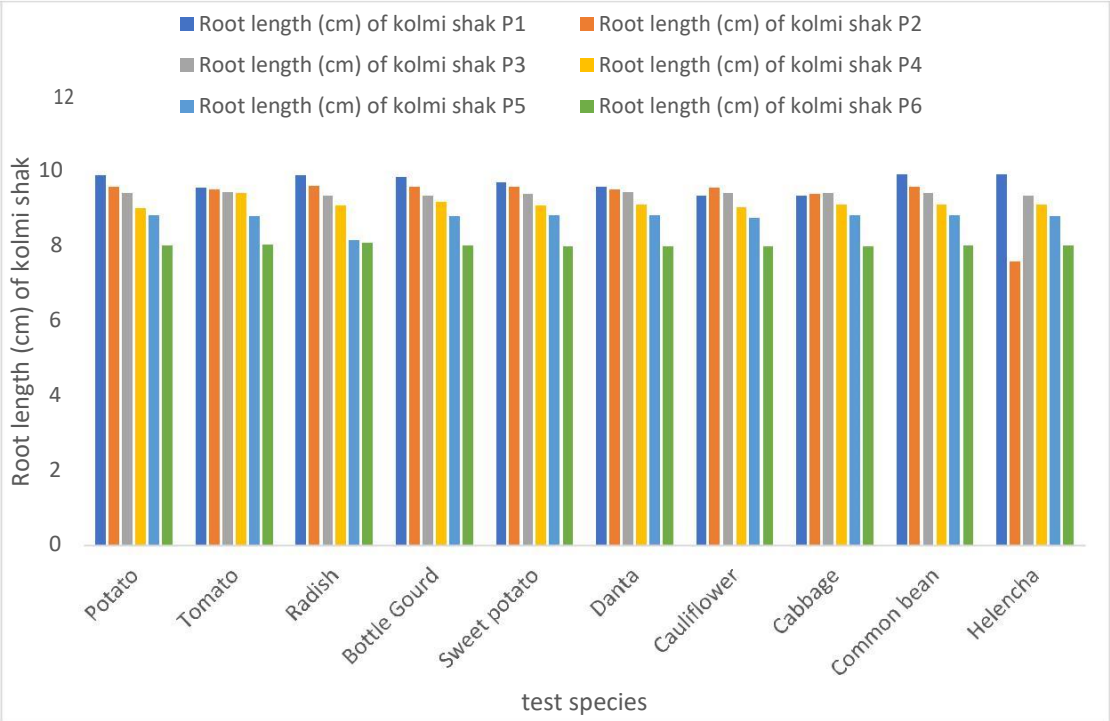
The aqueous solution of all vegetables had an effect on shoot length of kolmi shak and some variations was observed at different concentration of aqueous solution (Figure 2 and appendix VII, VIII, IX, X, XI, XII). Shoot length was affected by the different levels of extract of selected vegetables. The maximum shoot length was obtained in $P_1$ and minimum shoot length was obtained from $P_6$. But in $P_1$ treatment lowest was found from bottle gourd and sweet potato. In case of $P_6$ the lowest was recorded from Cauliflower and highest from tomato.


$P_1$= 0 ppm, $P_2$= 1 ppm, $P_3$= 2 ppm, $P_4$= 3 ppm, $P_5$= 4 ppm, $P_6$= 5 ppm.

**Figure 2. Effect of aqueous solution of ten vegetables on shoot length (cm) of kolmi shak**

### 4.1.3 Root length

The positively effect on root length throughout the growing season was recorded from different levels of extract concentration (Figure 3 and appendix XIII, XIV, XV, XVI, XVII, XVIII). The highest root length was obtained from $P_1$ the shortest root length was obtained from $P_6$. The shortest root length in $P_1$ was found from tomato and in case of P6 the lowest root length was recorded from danta, cauliflower and cabbage. This might be due to the presence of phytotoxic substances in those selected vegetables.

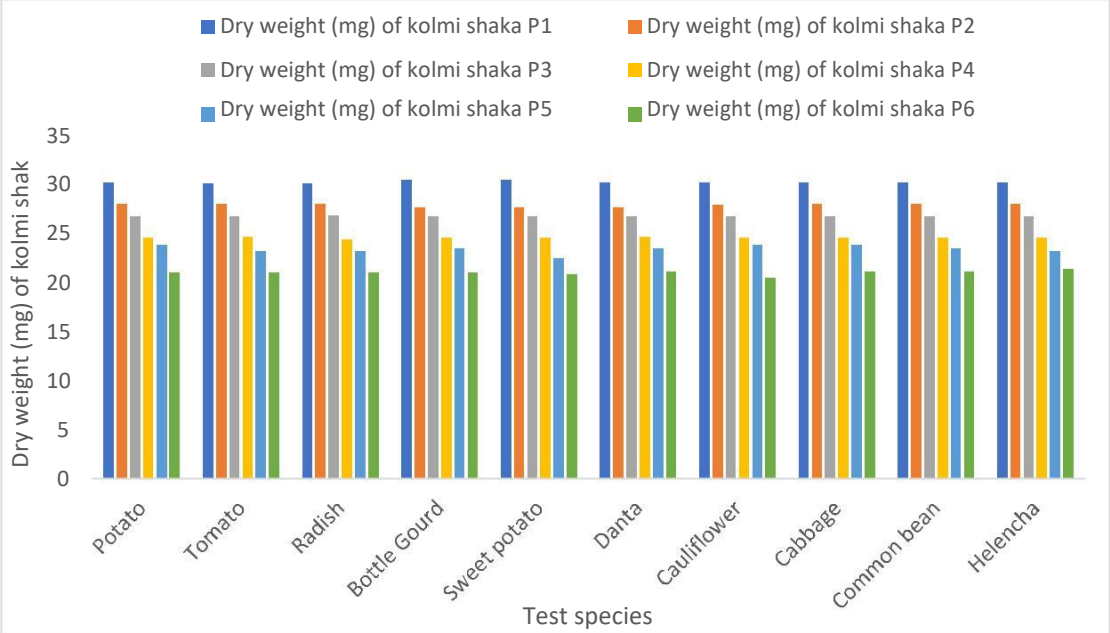



$P_1$= 0 ppm, $P_2$= 1 ppm, $P_3$= 2 ppm, $P_4$= 3 ppm, $P_5$= 4 ppm, $P_6$= 5 ppm.

**Figure 3. Effect of aqueous solution of ten vegetables on root length (cm) of kolmi shak**

### 4.1.3 Dry weight (mg)

The dry weight of kolmi shak was positively influenced due to different levels of aqueous solution application (Figure 4 and appendix XIX, XX, XXI, XXII, XXIII, XXIV). The highest dry weight produced from control treatment and the lowest dry weight was observed from $P_6$ treatment. This might be due to the presence of phytotoxic substances in those selected vegetables.



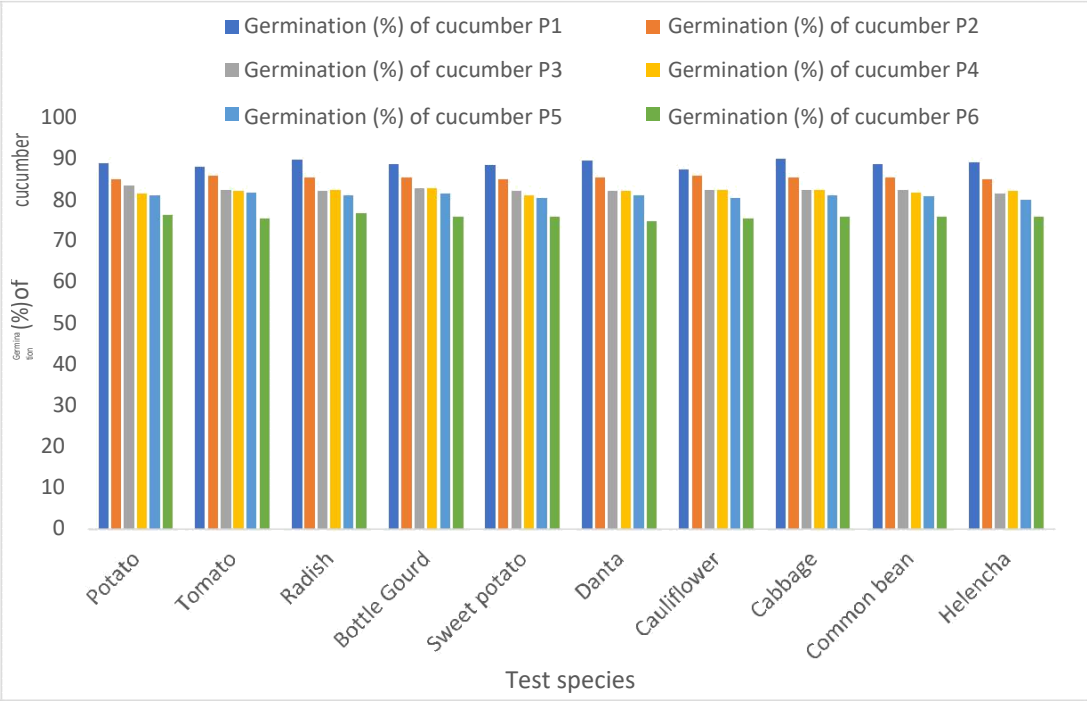

$P_1$= 0 ppm, $P_2$= 1 ppm, $P_3$= 2 ppm, $P_4$= 3 ppm, $P_5$= 4 ppm, $P_6$= 5 ppm.

**Figure 4. Effect of aqueous solution of ten vegetables on dry weight of kolmi shak**

## 4.2 Effect of aqueous solution on cucumber

### 4.2.1 Germination (%)

Germination (%) showed significant variations with the application of different levels of aqueous solutions. Data revealed that $P_6$ treatment produced the lowest germination percentage over other treatments and highest germination (%) was found from control treatment (Figure 5 and appendix XXV, XXVI, XXVII, XXVIII, XXIX, XXX). Cauliflower produced the lowest germination in $P_1$ aqueous solution and danta produced lowest in $P_6$ concentration.

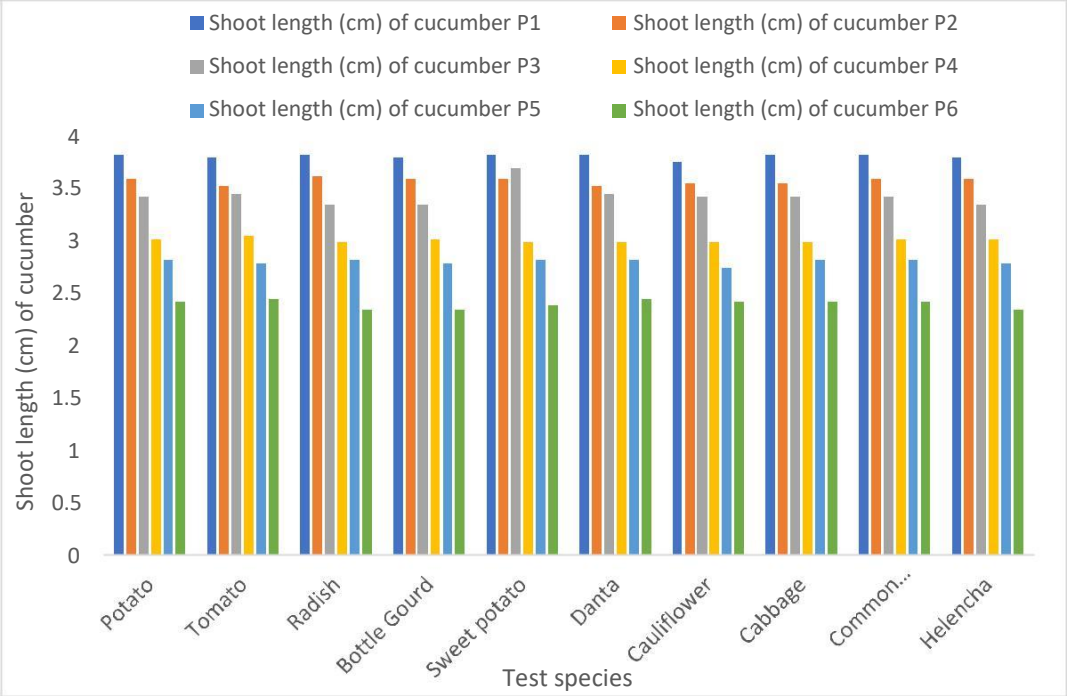



$P_1$= 0 ppm, $P_2$= 1 ppm, $P_3$= 2 ppm, $P_4$= 3 ppm, $P_5$= 4 ppm, $P_6$= 5 ppm.

**Table 5. Effect of aqueous solution of ten vegetables on germination (%) of cucumber**

### 4.2.2 Shoot length

Shoot length decreased gradually with the advancement of aqueous solution concentration. The lowest shoot length was obtained from the $P_6$ treatment and highest from control (Figure 6 and appendix XXXI, XXXII, XXXIII, XXXIV, XXXV, XXXVI). Cauliflower in $P_1$ produced the lowest shoot length where radish, bottle gourd and helencha produced the lowest shoot length in $P_6$ aqueous solution.



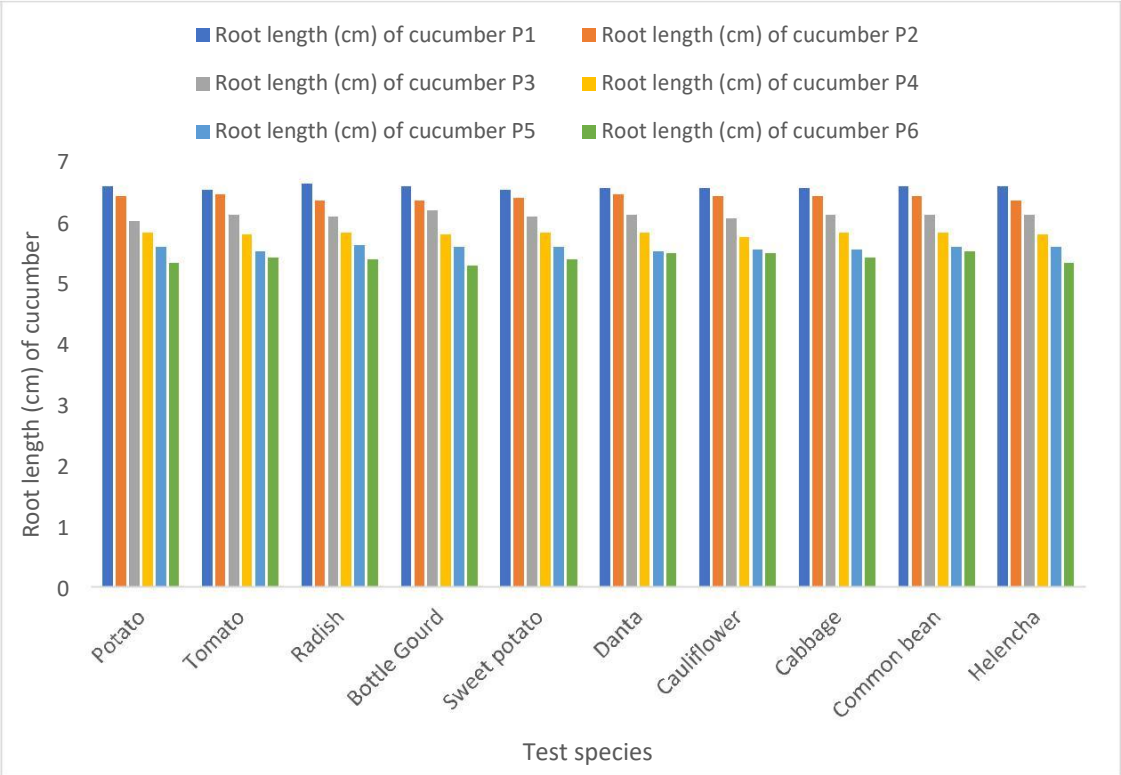

$P_1$= 0 ppm, $P_2$= 1 ppm, $P_3$= 2 ppm, $P_4$= 3 ppm, $P_5$= 4 ppm, $P_6$= 5 ppm.

**Figure 6. Effect of aqueous solution of ten vegetables on shoot length (cm) of cucumber**

### 4.2.3 Root length

Slower cell division in the root tips is the possible reason for smaller root length in aqueous solution treated seed than water treated seed. The variation among the vegetables was recorded in terms of root length of cucumber due to different aqueous solution concentrations (Figure 7 and appendix XXXVII, XXXVIII, XXXIX, XXXX, XXXXI, XXXXII). The root length decreased up to $P_6$ concentration and the highest root length was found in $P_1$ treatment. The maximum root length was observed from

$P_1$ solution due to tomato and sweet potato where in $P_6$ solution sweet potato gave the lowest root length in cucumber.

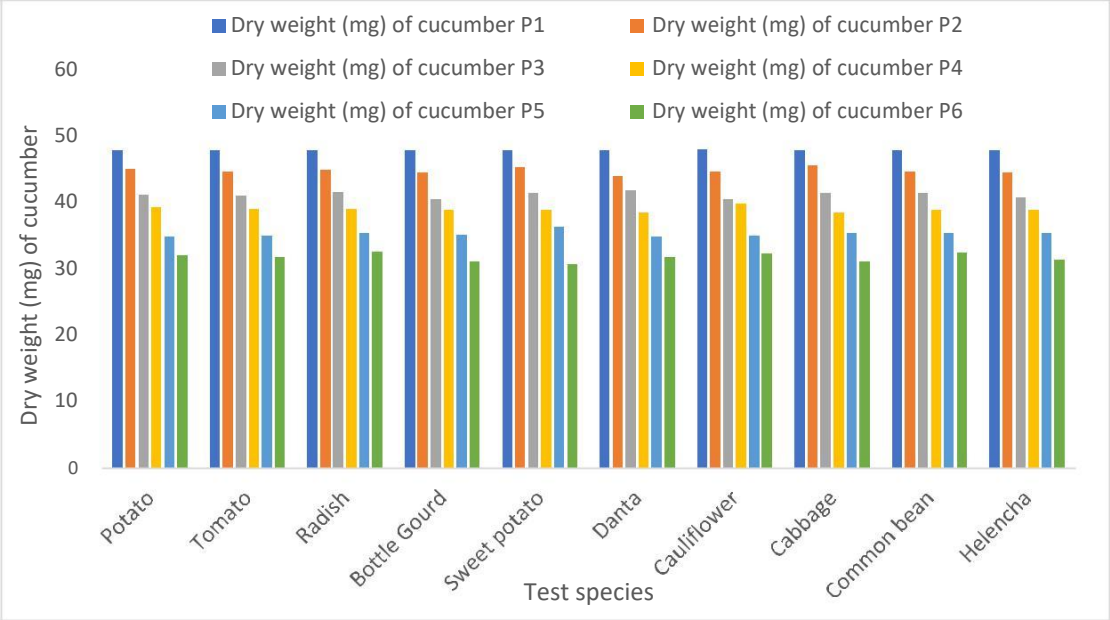



$P_1$= 0 ppm, $P_2$= 1 ppm, $P_3$= 2 ppm, $P_4$= 3 ppm, $P_5$= 4 ppm, $P_6$= 5 ppm.

**Figure 7. Effect of aqueous solution of ten vegetables on root length (cm) of cucumber**

### 4.2.3 Dry weight (mg)

The positively significant variation for dry weight of cucumber was observed due to the effect of aqueous solution concentration (Figure 8 and appendix XXXXIII, XXXXIV, XXXXV, XXXXVI, XXXXVII, XXXXVIII). $P_6$ treatment produced lowest dry weight and control produced the highest dry weight.




$P_1$= 0 ppm, $P_2$= 1 ppm, $P_3$= 2 ppm, $P_4$= 3 ppm, $P_5$= 4 ppm, $P_6$= 5 ppm.

**Figure 8. Effect of aqueous solution of ten vegetables on dry weight (mg) of cucumber**

# CHAPTER V

## SUMMARY AND CONCLUSION

Aqueous solution of 10 selected vegetables namely potato, tomato, radish, bottle gourd, sweet potato, danta, cauliflower, cabbage, common bean, helencha were applied on the test crops i.e. kolmi shak and cucumber.

Result indicated that the highest germination found in control treatment and lowest from 5ppm aqueous solution. In case of two selected crops, aqueous solution showed the positive result to suppress these crops. Similarly, the highest values of shoot length, root length and dry weight were observed from control and lowest from 5 ppm aqueous solution.

So, it can be concluded that potato, tomato, radish, bottle gourd, sweet potato, danta, cauliflower, cabbage, common bean, helencha had a positive allelopathic effect to suppress the associated crops. With an increasing the concentration of aqueous solution it showed faster effect as well as quick result.

To validate this finding, it is recommended to conduct more research by changing the test weeds. Even it was a pot experiment in the net house, so it should to conduct a field experiment at different locations in Bangladesh for further evaluation.

## REFERENCES


Akbari, G., Sanavy, S.A. and Yousefzadeh, S. (2007). Effect of auxin and salt stress (NaCl) on seed germination of wheat cultivars (*Triticum aestivum* L.). *Pak. J. Biol. Sci*. **10**: 2557–2561.

Anjum, A., Hussain, U., Yousaf, Z., Khan, F. and Umer, A. (2010). Evaluation of allelopathic action of some selected medicinal plant on lettuce seeds by using sandwich method. *J. Med. Plants Res.*, **4**(7): 536-541.

Appel, H. M. (1993). Phenolics in ecological interactions: the importance of oxidation. *J. Chem. Ecol.*, **19**: 1521-1552.

ARDI. (1986). Influence between sweet-corn (*Zea mays* L.) and purple nutsedge (*Cyperus rotundus* L.) at different irrigation levels. M.S. thesis, University of Hawaii, Honolulu.

Barnes, J.P. and Putnam, A.R. (1983). Rye residues contribute weed suppression in no-tillage cropping systems. *J. Chem. Ecol.* **9**:1045–1057.

Belz, R.G., Vanderlaan, M., Reinhardt, C.F. and Hurle. K. (2009). Soil degradation of parthenin. Does it contradict the role of allelopathy in the invasive weed *Parthenium hysterophorus* L.? *J. Chem. Ecol.*, **35**: 1137-1150.

Bertholdsson, N. O. (2004). Variation in allelopathic activity over 100 years of barley selection and breeding. *Weed Res*., **44**:78–86.

Bertin, C., Paul, R.N., Duke, S.O., and Weston, L.A. (2003). Laboratory assessment of the allelopathic potential of fine leaf fescues (*Festuca rubra* L.). *J. Chem. Ecol*., **8**:1919–1937.

Blum, U. and Shafer, S. R. (1988). Microbial populations and phenolic acids in soil. *Soil Biol. Biochem.*, **20**: 793-800.

Blum, U. (1998). Effects of microbial utilization of phenolic acids and their phenolic acid breakdown products on allelopathic interactions. *J. Chem. Ecol.*, **24**(4): 685-708.

Blum, U. (1995). The value of model plant–microbe–soil system for understanding processes associated with allelopathic interactions, p. 127–131. In: Inderjit, K.M.M. Dakshini, and F.A. Einhellig (eds.). Allelopathy, organisms, processes and applications. Amer. Chem. Soc. Symp. Ser. 582. Washington D.C.

Blum, U. (2002). Soil solution concentrations of phenolic acids as influenced by evapotranspiration. Third World Congr. Allelopathy. Abstr. No. 56.

Blum, U. and Shafer, S. R. (1988). Microbial populations and phenolic acids in soil. *Soil Biol. Biochem.*, **20**(6): 793-800.

Burgos, N. R. and Talbert, R. E. (2000). Differential activity of allelochemicals from Secale cereale in seedling bioassays. *Weed Sci.*, **48**(3): 302-310.

Burgos, N.R., Talbert, R.E. and Mat- tice, J.D. (1999). Cultivar and age differences in the production of allelochemicals by *Secale cereale*. *Weed Sci*., **47**:481–485.

Cheema, Z.A. (1988). Weed control in wheat through sorghum allelochemicals. Ph.D. Thesis University of Agriculture, Faisalabad, Pakistan. interference: Theoretical principles. J. Chem. Ecol. **9**: 9.

Chou, C.H. (1995). Allelopathy and sustainable agriculture. In: K. M. Inderjit, M. Dakshini, and F. A. Einhellig, eds. Processes and Applications. ACS symposium Series 582, pp. 211-223. American Chemical Society, Washington, DC.

Corcuera, L. J. (1993). Biochemical basis for the resistance of barley to aphids. *Phytochemistry*, **33**(4): 741-747.

Duke, S. O., Scheffler, B. E., Dayan, F. E., Weston, L. A., and Ota, E. (2001). Strategies for using transgenes to produce allelopathic crops. *Weed Technol.*, **15**(4): 826-834.

Duke, S.O., Scheffler, B.E., Dayan, F.E., Weston, L.A. and Ota, E. (2001). Strategies for using transgenes to produce allelopathic crops. *Weed Technol*., **15**:826–834.

Duke, S.O., Dayan, F.E., Rimando, A.M., Shrader, K., Aliotta, G., Oliva, A. and Romagni, J.G. (2002). Chemicals from nature for weed management. *Weed Sci.*, **50**:138–151.

Einheling, F.A. (1989). Interactive effects of allelochemicals and environmental stress. Pp. 101-118 in C. H. Chou & G. R. Waller (eds.), Phytochemical ecology: allelochemicals, mycotoxins, and insect pheromones and allomones. Institute of Botany, Academia Sinica, Monograph Series No. 9, Talpei. 9 1996. Interactions involving allelopathy in cropping systems. *Agron. J.*, **88**: 886-893.

Einhellig F.A. (1987). Interactions among allelochemicals and other stress factors of the plant environment. In G.R Waller (ed.). Allelochemicals: Role In agriculture and forestry. American Chemical Society Washington DC. pp.343-357.

Einhellig, F. A., and Rasmussen, J. A. (1989). Prior cropping with grain sorghum inhibits weeds. *J. Chem. Ecol.*, **15**(3): 951-960.

Einhellig, F.A. (1995). Mechanism of action of allelochemical in allelopathy. In: Allelopathy organisms, processes and application. American Chemical Society, Washington, USA-116.

Einhellig, F.A. (2004). Mode of allelochemical action of phenolic, pp 96compounds. In Allelopathy: Chemistry and mode of action of allelochemicals. (Eds FA Macias, JCG Galindo, JMG Molinillo, HG Cutler) pp. 217-238.

Foy, C.L. and Inderjit, A.U. (2001). Understanding the role of allelopathy in weed interference and declining plant diversity. *Weed Technol.*, **15**: 873–876.

Gershenzon, J. (1984). Changes in the levels of plant secondary metabolites under water and nutrient stress. *Recent Adv. Phytochemistry*, **18**: 273-320.

Hassan, M. M., Daffalla, H. M., Yagoub, S. O., Osman, M. G., Gani, M. E. A., and Babiker, A. G. E. (2012). Allelopathic effects of some botanical extracts on germination and seedling growth of *Sorghum bicolor* L. *J. Agric. Technol.*, **8**(4), 1423-1469.

Hierro, J. and Callaway, R.M. (2003). Allelopathy and exotic plant invasion. *Plant Soil*, **256**: 29-39.

Hirai, N. (2003). Application of Allelochemicals to Agriculture. *Biol. Invasion Space*. **17**: 4-5.

Inderjit, A.U. and Weaner, J. (2001). Plant allelochemical interference or soil chemical ecology? *Per. Plant Ecol. Evol. Syst.*, **41**: 3-12.

Inderjit, A.U. and Keating, K.I. (1999). Allelopathy: principles, procedures, processes, and promises for biological control. *Adv. Agron.*, **67**:141–231

Inderjit, A.U. and Weaner, J. (2001). Plant allelochemical interference or soil chemical ecology? *Perspect. Plant Ecol. Evol. Sys.*, **41**: 3-12.

Inderjit, A.U. (1998). Influence of *Pluchea lanceolata* (Asteraceae) on selected soil properties. *Am. J. Bot.*, **85**: 64-69.

Inderjit, A.U., Asakawa, C. and Dakshini K.M. (1999). Allelopathic potential of *Vebesina encelioides* root leachate in soil. *Can. J. Bot.*, **77**: 1419-1424.

Irshad S. and Cheema, P. (2004). Allelopathic effects of selected vegetable plants on *Amaranthus retroflexus* and *Chenopodium murale*. *Allelopathy J*., **10** (2): 105-122.

ISTA (2003). International Seed Testing Association, ISTA Handbook on Seedling Evaluation, 3rd ed.

Khalid, S., Ahmad, T., and Shad, R. A. (2002). Use of allelopathy in agriculture. *Asian J. Plant Sci.*, **1**(3), 292-297.

Khanh, T. D., Chung, M. I., Xuan, T. D., and Tawata, S. (2005). The exploitation of crop allelopathy in sustainable agricultural production. *J. Agron. Crop Sci.*, **191**(3), 172-184.

Kimber, R. W. W. (1973). Phytotoxicity from plant residues. III. The relative effect of toxins and nitrogen immobilization on germination and growth of weed. *Plant Soil,* **38**: 543 - 555

Koeppe, D. E., Southwick, L. M., and Bittell, J. E. (1976). The relationship of tissue chlorogenic acid concentrations and leaching of phenolics from sunflowers grown under varying phosphate nutrient conditions. *Can. J. Bot.*, **54(**7): 593-599.

Macias, F. A., Molinillo, J. M. G., Oliveros-bastidas, A., Marin, D. and Chinchilla, D. (2004). Allelopathy. A natural strategy for weed control. *Commun. Agric. Appl. Biol. Sci.*, **69**: 13-23.

Macias, F. A., Molinillo, J. M. G., Oliveros-Bastidas, A., Marin, D. and Chinchilla, D. (2004). Allelopathy. A natural strategy for weed control. *Commun. Appl. Biol. Sci.,* **69**: 13-23.

Mamolos, A. P. and Kalburtji, K. L. (2001). Significance of allelopathy in crop rotation. *J. Crop Prod.*, **4**:197- 218.

Mandava, N.B. (1985). Chemistry and biology of allelopathic agents. In: The Chemistry of Allelopathy: Biochemical interactions among plants. A. C. Thompson (Ed), American Chemistry Society, Washington, pp. 33-54.

Masiunas, J.B., Weston, L.A. and Weller, S.C. (1995). The impact of rye cover crops on weed populations in a tomato cropping system. *Weed Sci*., **43**:318–323

Moyer, J.R., Blackshaw, R.E., Smith, E.G. and McGinn, S. (2000). Cereal cover crops for weed suppression in a summer fallow-wheat cropping sequence. *Can. J. Plant Sci*. 80:441–449.

Muller, C.H. (1969). Allelopathy as a factor in ecological process. Vegetation. *Plant Ecol.*, **18**:348–357.

Mwaja, V.N., Masiunas, J.B. and Weston, L.A. (1995). Effects of fertility on biomass, phytotoxicity, and allelochemical content of cereal rye. *J. Chem. Ecol*., **21**:81–96.

Niemeyer, H. M. (1988). Hydroxamic acids (4-hydroxy-1, 4-benzoxazin-3-ones), defence chemicals in the Gramineae. *Phytochemistry*, 27(11), 3349-3358.

Othman, Y., Al-Karaki, G., Al-Tawaha, A.R. and Al-Horani, A. (2006). Variation in germination and ion uptake in barley genotypes under salinity conditions. *World J. Agril. Sci.* **2**(1): 11-15.

Petersen, J., Belz, R., Walker, F. and Hurle, K. (2001). Weed suppression by release of isothiocyanates from turnip-rape mulch. *Agron. J*., **93**: 37–43.

Putnam, A. R. (1983). Allelopathic chemicals-natures herbicides in action. *Chem. Eng. News*, **61**(14): 34-45.

Putnam, A. R. and Duke, W. O. (1974). Biological suppression of weeds; Evidence for allelopathy in accession of cucumber. *Science*., **185**: 370-372.

Putnam, A. R. and Duke, W. O. (1978). Allelopathy in agroecosystems. *Ann. Rev. Phytopathol*., **16**: 431-451.

Putnam, A. R. and Weston, L. A. (1978). Adverse impacts of allelopathy in agricultural systems, p. 43-56. In: A.R. Putnam and C.S. Tangs (eds.). The science of allelopathy. Wiley, New York.

Putnam, A.R. (1988). Allelochemicals from plants as herbicides. *Weed Technol*., **2**: 510–518.

Qasem, J. R. and Foy, C. I. (2001). Weed allelopathy, its ecological impacts and future prospects: A review, p. 43-119. In. R.K. Kohli, H.P. Singh and D.R. Batish (eds.). Allelopathy in agroecosystems. Haworth Press, New York.

Rice, E.L. (1984). Allelopathy. 2nd Edn. Academic Press, Orlando, Florida.

Rice, E.L. (1995). Biological Control of Weeds and Plant Diseases: Advances in Applied Allelopathy. Norman, OK: University of Oklahoma Press, pp. 439.

Sene, M., Gallet, C. and Dore, T. (2001). Phenolic compounds in a Sahelian sorghum (*Sorghum bicolor*) genotype [ce(145–66)] and associated soils. *J. Chem. Ecol.*, **27**: 81–92.

Shaukat, S. S., Munir, N., and Siddiqui, I. A. (2003). Allelopathic responses of Conyza canadensis (L.) Cronquist: a cosmopolitan weed. *Asian J. Plant Sci.*, **2**(14): 1034-1039.

Shilling, D.G., Liebl, R.A., and Worsham, A.D. (1985). Rye (*Secale cereale* L.) and wheat (*Triticum aestivum* L.) mulch: The suppression of certain broadleaved weeds and the isolation and identification of phytotoxins, p. 243–271. In: A.R. Put- nam and C.S. Tang (eds.). The science of allelopathy. Wiley, New York.

Singh, H.P., Batish, D.R., and Kohli, R.K. (2001). Allelopathy in agroecosystems: An overview. *J. Crop Prod*., **4**: 1-41.

Wardle, D. A., Nilsson, M. C., Gallet, C. and Zackrisson, O. (1998). An ecosystem-level perspective of allelopathy. *Biol. Rev.*, **73**(3): 305-319.

Weston, L. A., and Duke, S. O. (2003). Weed and crop allelopathy. *Critical Rev. Plant Sci.*, **22**(3-4): 367-389.

Weston, L.A. (1996). Utilization of allelopathy and crop allelopathy. *Critical Rev. Plan Sci*., **22**:367-389.

Weston, L.A. (1996). Utilization of allelopathy for weed management in agroecosys- tems. *Agron. J*., **88**: 860–866.

Weston, L.A., Harmon, R. and Mueller, S. (1989). Allelopathic potential of sorghum- sudangrass hybrid (sudex). *J. Chem. Ecol.*, **15**: 1855–1865.

Whittaker, R. H., and Feeny, P. P. (1971). Allelochemics: chemical interactions between species. *Science*, **171**(3973): 757-770.

Williamson, G. B. (1990) Allelopathy, Koch‘s postulates, and the neck riddle. In: Grace JB, Tilman D (eds) Perspectives onplant competition. Academic Press, San Diego, Calif., pp143–162.

Yang, X., Scheffler, B. and Weston, L.A. (2004). Cloning of SOR 1, a gene associated with bioherbicide production in sorghum root hairs. *J. Expt. Bot.*, **55**: 2251–2259.

# APPENDICES

**Appendix I. Effect of aqueous solution $P_1$ of ten vegetables on germination (%) of kolmi shak**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 10.033 | 1.11481 | 0.20 | 0.9916 |
| Error | 20 | 112.667 | 5.63333 | | |
| Total | 29 | 122.700 | | | |

**Appendix II. Effect of aqueous solution $P_2$ of ten vegetables on germination (%) of kolmi shak**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 1.6333 | 0.18148 | 0.06 | 0.9999 |
| Error | 20 | 62.6667 | 3.13333 | | |
| Total | 29 | 64.3000 | | | |

**Appendix III. Effect of aqueous solution $P_3$ of ten vegetables on germination (%) of kolmi shak**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 3.2000 | 0.35556 | 0.15 | 0.9972 |
| Error | 20 | 48.6667 | 2.43333 | | |
| Total | 29 | 51.8667 | | | |

**Appendix IV. Effect of aqueous solution $P_4$ of ten vegetables on germination (%) of kolmi shak**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 4.0333 | 0.44815 | 0.24 | 0.9826 |
| Error | 20 | 36.6667 | 1.83333 | | |
| Total | 29 | 40.7000 | | | |

**Appendix V. Effect of aqueous solution $P_5$ of ten vegetables on germination (%) of kolmi shak**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 37.633 | 4.18148 | 0.53 | 0.8378 |
| Error | 20 | 158.667 | 7.93333 | | |
| Total | 29 | 196.300 | | | |

**Appendix VI. Effect of aqueous solution $P_6$ of ten vegetables on germination (%) of kolmi shak**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 7.2000 | 0.80000 | 0.38 | 0.9337 |
| Error | 20 | 42.6667 | 2.13333 | | |
| Total | 29 | 49.8667 | | | |

**Appendix VII. Effect of aqueous solution $P_1$ of ten vegetables on shoot length (cm) of kolmi shak**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 0.05633 | 0.00626 | 0.13 | 0.9984 |
| Error | 20 | 0.99333 | 0.04967 | | |
| Total | 29 | 1.04967 | | | |

**Appendix VII. Effect of aqueous solution $P_2$ of ten vegetables on shoot length (cm) of kolmi shak**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 0.02833 | 0.00315 | 0.18 | 0.9938 |
| Error | 20 | 0.34667 | 0.01733 | | |
| Total | 29 | 0.37500 | | | |

**Appendix IX. Effect of aqueous solution $P_3$ of ten vegetables on shoot length (cm) of kolmi shak**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 0.04167 | 0.00463 | 0.19 | 0.9923 |
| Error | 20 | 0.48000 | 0.02400 | | |
| Total | 29 | 0.52167 | | | |

**Appendix X. Effect of aqueous solution $P_4$ of ten vegetables on shoot length (cm) of kolmi shak**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 0.05500 | 0.00611 | 0.33 | 0.9531 |
| Error | 20 | 0.36667 | 0.01833 | | |
| Total | 29 | 0.42167 | | | |

**Appendix XI. Effect of aqueous solution $P_5$ of ten vegetables on shoot length (cm) of kolmi shak**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 0.01467 | 0.00163 | 0.07 | 0.9999 |
| Error | 20 | 0.50000 | 0.02500 | | |
| Total | 29 | 0.51467 | | | |

**Appendix XII. Effect of aqueous solution $P_6$ of ten vegetables on shoot length (cm) of kolmi shak**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 0.01500 | 0.00167 | 0.07 | 0.9998 |
| Error | 20 | 0.46667 | 0.02333 | | |
| Total | 29 | 0.48167 | | | |

**Appendix XIII. Effect of aqueous solution $P_1$ of ten vegetables on root length (cm) of kolmi shak**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 1.10700 | 0.12300 | 2.35 | 0.0535 |
| Error | 20 | 1.04667 | 0.05233 | | |
| Total | 29 | 2.15367 | | | |

**Appendix XIV. Effect of aqueous solution $P_2$ of ten vegetables on root length (cm) of kolmi shak**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 10.5200 | 1.16889 | 0.88 | 0.5579 |
| Error | 20 | 26.5467 | 1.32733 | | |
| Total | 29 | 37.0667 | | | |

**Appendix XV. Effect of aqueous solution $P_3$ of ten vegetables on root length (cm) of kolmi shak**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 0.04167 | 0.00463 | 0.19 | 0.9923 |
| Error | 20 | 0.48000 | 0.02400 | | |
| Total | 29 | 0.52167 | | | |

**Appendix XVI. Effect of aqueous solution $P_4$ of ten vegetables on root length (cm) of kolmi shak**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 0.32800 | 0.03644 | 1.00 | 0.4690 |
| Error | 20 | 0.72667 | 0.03633 | | |
| Total | 29 | 1.05467 | | | |

**Appendix XVII. Effect of aqueous solution $P_5$ of ten vegetables on root length (cm) of kolmi shak**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 0.34833 | 0.03870 | 0.83 | 0.5976 |
| Error | 20 | 0.93333 | 0.04667 | | |
| Total | 29 | 1.28167 | | | |

**Appendix XVIII. Effect of aqueous solution $P_6$ of ten vegetables on root length (cm) of kolmi shak**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 0.02967 | 0.00330 | 0.13 | 0.9984 |
| Error | 20 | 0.52000 | 0.02600 | | |
| Total | 29 | 0.54967 | | | |

**Appendix IXX. Effect of aqueous solution $P_1$ of ten vegetables on dry weight (mg) of kolmi shak**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 0.34700 | 0.03856 | 0.71 | 0.6940 |
| Error | 20 | 1.08667 | 0.05433 | | |
| Total | 29 | 1.43367 | | | |

**Appendix XX. Effect of aqueous solution $P_2$ of ten vegetables on dry weight (mg) of kolmi shak**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 0.68167 | 0.07574 | 1.26 | 0.3153 |
| Error | 20 | 1.20000 | 0.06000 | | |
| Total | 29 | 1.88167 | | | |

**Appendix XXI. Effect of aqueous solution $P_3$ of ten vegetables on dry weight (mg) of kolmi shak**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 0.02833 | 0.00315 | 0.18 | 0.9938 |
| Error | 20 | 0.34667 | 0.01733 | | |
| Total | 29 | 0.37500 | | | |

**Appendix XXII. Effect of aqueous solution $P_4$ of ten vegetables on dry weight (mg) of kolmi shak**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 0.16667 | 0.01852 | 0.77 | 0.6437 |
| Error | 20 | 0.48000 | 0.02400 | | |
| Total | 29 | 0.64667 | | | |

**Appendix XXIII. Effect of aqueous solution $P_5$ of ten vegetables on dry weight (mg) of kolmi shak**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 135.256 | 15.0285 | 1.15 | 0.3749 |
| Error | 20 | 260.987 | 13.0493 | | |
| Total | 29 | 396.243 | | | |

**Appendix XXIV. Effect of aqueous solution $P_6$ of ten vegetables on dry weight (mg) of kolmi shak**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 1.34700 | 0.14967 | 1.33 | 0.2819 |
| Error | 20 | 2.24667 | 0.11233 | | |
| Total | 29 | 3.59367 | | | |

**Appendix XXV. Effect of aqueous solution $P_1$ of ten vegetables on germination (%) of cucumber**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 16.7000 | 1.85556 | 1.14 | 0.3841 |
| Error | 20 | 32.6667 | 1.63333 | | |
| Total | 29 | 49.3667 | | | |

**Appendix XXVI. Effect of aqueous solution $P_2$ of ten vegetables on germination (%) of cucumber**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 1.6333 | 0.18148 | 0.06 | 0.9999 |
| Error | 20 | 62.6667 | 3.13333 | | |
| Total | 29 | 64.3000 | | | |

**Appendix XXVII. Effect of aqueous solution $P_3$ of ten vegetables on germination (%) of cucumber**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 7.2000 | 0.80000 | 0.38 | 0.9337 |
| Error | 20 | 42.6667 | 2.13333 | | |
| Total | 29 | 49.8667 | | | |

**Appendix XXVII. Effect of aqueous solution $P_4$ of ten vegetables on germination (%) of cucumber**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 6.9667 | 0.77407 | 0.39 | 0.9275 |
| Error | 20 | 40.0000 | 2.00000 | | |
| Total | 29 | 46.9667 | | | |

**Appendix XXIX. Effect of aqueous solution $P_5$ of ten vegetables on germination (%) of cucumber**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 6.8333 | 0.75926 | 0.52 | 0.8447 |
| Error | 20 | 29.3333 | 1.46667 | | |
| Total | 29 | 36.1667 | | | |

**Appendix XXX. Effect of aqueous solution $P_6$ of ten vegetables on germination (%) of cucumber**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 8.0000 | 0.88889 | 0.44 | 0.8987 |
| Error | 20 | 40.6667 | 2.03333 | | |
| Total | 29 | 48.6667 | | | |

**Appendix XXXI. Effect of aqueous solution $P_1$ of ten vegetables on shoot length (cm) of cucumber**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 0.01500 | 0.00167 | 0.07 | 0.9998 |
| Error | 20 | 0.46667 | 0.02333 | | |
| Total | 29 | 0.48167 | | | |

**Appendix XXXII. Effect of aqueous solution $P_2$ of ten vegetables on shoot length (cm) of cucumber**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 0.02833 | 0.00315 | 0.18 | 0.9938 |
| Error | 20 | 0.34667 | 0.01733 | | |
| Total | 29 | 0.37500 | | | |

**Appendix XXXIII. Effect of aqueous solution $P_3$ of ten vegetables on shoot length (cm) of cucumber**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 0.04167 | 0.00463 | 0.19 | 0.9923 |
| Error | 20 | 0.48000 | 0.02400 | | |
| Total | 29 | 0.52167 | | | |

**Appendix XXXIV. Effect of aqueous solution $P_4$ of ten vegetables on shoot length (cm) of cucumber**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 0.01467 | 0.00163 | 0.07 | 0.9999 |
| Error | 20 | 0.50000 | 0.02500 | | |
| Total | 29 | 0.51467 | | | |

**Appendix XXXV. Effect of aqueous solution $P_5$ of ten vegetables on shoot length (cm) of cucumber**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 0.01500 | 0.00167 | 0.07 | 0.9998 |
| Error | 20 | 0.46667 | 0.02333 | | |
| Total | 29 | 0.48167 | | | |

**Appendix XXXVI. Effect of aqueous solution $P_6$ of ten vegetables on shoot length (cm) of cucumber**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 0.04167 | 0.00463 | 0.19 | 0.9923 |
| Error | 20 | 0.48000 | 0.02400 | | |
| Total | 29 | 0.52167 | | | |

**Appendix XXXVII. Effect of aqueous solution $P_1$ of ten vegetables on root length (cm) of cucumber**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| A | 9 | 0.02833 | 0.00315 | 0.18 | 0.9938 |
| Error | 20 | 0.34667 | 0.01733 | | |
| Total | 29 | 0.37500 | | | |

**Appendix XXXVIII. Effect of aqueous solution $P_2$ of ten vegetables on root length (cm) of cucumber**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| A | 9 | 0.04167 | 0.00463 | 0.19 | 0.9923 |
| Error | 20 | 0.48000 | 0.02400 | | |
| Total | 29 | 0.52167 | | | |

**Appendix XXXIX. Effect of aqueous solution $P_3$ of ten vegetables on root length (cm) of cucumber**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 0.05500 | 0.00611 | 0.33 | 0.9531 |
| Error | 20 | 0.36667 | 0.01833 | | |
| Total | 29 | 0.42167 | | | |

**Appendix XXXX. Effect of aqueous solution $P_4$ of ten vegetables on root length (cm) of cucumber**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 0.01500 | 0.00167 | 0.07 | 0.9998 |
| Error | 20 | 0.46667 | 0.02333 | | |
| Total | 29 | 0.48167 | | | |

**Appendix XXXXI. Effect of aqueous solution $P_5$ of ten vegetables on root length (cm) of cucumber**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 0.02833 | 0.00315 | 0.18 | 0.9938 |
| Error | 20 | 0.34667 | 0.01733 | | |
| Total | 29 | 0.37500 | | | |

**Appendix XXXXII. Effect of aqueous solution $P_6$ of ten vegetables on root length (cm) of cucumber**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 0.16833 | 0.01870 | 0.95 | 0.5056 |
| Error | 20 | 0.39333 | 0.01967 | | |
| Total | 29 | 0.56167 | | | |

**Appendix XXXXIII. Effect of aqueous solution $P_1$ of ten vegetables on dry weight (mg) of cucumber**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 0.05633 | 0.00626 | 0.13 | 0.9984 |
| Error | 20 | 0.99333 | 0.04967 | | |
| Total | 29 | 1.04967 | | | |

**Appendix XXXXIV. Effect of aqueous solution $P_2$ of ten vegetables on dry weight (mg) of cucumber**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 5.3083 | 0.58981 | 0.56 | 0.8163 |
| Error | 20 | 21.2133 | 1.06067 | | |
| Total | 29 | 26.5217 | | | |

**Appendix XXXXV. Effect of aqueous solution $P_3$ of ten vegetables on dry weight (mg) of cucumber**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 4.4283 | 0.49204 | 0.68 | 0.7159 |
| Error | 20 | 14.4133 | 0.72067 | | |
| Total | 29 | 18.8417 | | | |

**Appendix XXXXVI. Effect of aqueous solution $P_4$ of ten vegetables on dry weight (mg) of cucumber**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 3.8430 | 0.42700 | 0.52 | 0.8422 |
| Error | 20 | 16.3867 | 0.81933 | | |
| Total | 29 | 20.2297 | | | |

**Appendix XXXXVII. Effect of aqueous solution $P_5$ of ten vegetables on dry weight (mg) of cucumber**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 4.8963 | 0.54404 | 0.68 | 0.7155 |
| Error | 20 | 15.9267 | 0.79633 | | |
| Total | 29 | 20.8230 | | | |

**Appendix XXXXVIII. Effect of aqueous solution $P_6$ of ten vegetables on dry weight (mg) of cucumber**

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Treat | 9 | 11.3653 | 1.26281 | 2.37 | 0.0518 |
| Error | 20 | 10.6533 | 0.53267 | | |
| Total | 29 | 22.0187 | | | |

**Sample Preparation**

**Sample Application**

Plate 1

Plate 2

Plate 3

Plate 4

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| **Author** | MD. KABIRUL ISLAM |
| **Department** | Agricultural Chemistry |
| **University** | Sher-e-Bangla Agricultural University |
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