INFLUENCE OF SPACING AND WEEDING ON THE PERFORMANCE OF BLACKGRAM

BY

MD. SHAMSUZZOHA KHANDAKER

REGISTRATION NO. 27616/ 00759

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Approved by:

(Prof. Dr. A. K. M. Ruhul Amin)
Supervisor

(Prof. Dr. Md. Fazlul Karim)
Co-Supervisor

Prof. Dr. Md. Jafar Ullah)
Chairman
Examination Committee

Dedicated to
My
Beloved Parents

CERTIFICATE

This is to certify that the thesis entitled, "**INFLUENCE OF WEEDING AND SPACING ON THE PERFORMANCE OF BLACKGRAM**" submitted to the Department of Agronomy, Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka in partial fulfilment 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 **MD. SHAMSUZZOHA KHANDAKER, Registration No. 27616/00759** 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 been duly acknowledged by him.

Dated: 26.6.08
Dhaka, Bangladesh

(Prof. Dr. A. K. M. Ruhul Amin)
Supervisor

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INFLUENCE OF WEEDING AND SPACING ON THE PERFORMANCE OF BLACKGRAM

ABSTRACT

The study was carried out at the research field of Sher-e- Bangla Agricultural University, Dhaka during 31 March 2007 to 8 June 2007 to evaluate the effect time of weeding and spacing on the yield performance of blackgram. The treatment comprised of three levels of weeding viz. no weeding, one weeding at 25 DAS and two weedings at 25 and 40 DAS, and four types of spacings viz. 30cm ×7 cm, 30cm ×10 cm, 30cm ×13 cm and 30cm ×16 cm. The experiment was laid out in a randomized complete block design factorial. Two times of weeding, (at 25 and 40 DAS) increased grain yield with higher values of harvest index as the crop characters like plant height, branches plant^{-1}, number of leaflets plant^{-1}, number of flowers plant^{-1}, number of pods plant^{-1}, seeds pod^{-1}, dry weight plant^{-1}, yield plant^{-1} and 1000 seed weight were higher. The seed yield with two weeding was 56.18% and 25.23% higher than no weeding and one weeding respectively. The spacing, 30cm ×10 cm showed its superiority by producing 7.96%, 8.92% and 16.19% higher yield than 30cm ×7 cm, 30cm ×13 cm and 30cm ×16 cm spacing, respectively. The 30cm ×10 cm spacing also showed higher biological yield and harvest index. Interaction of two weeding with 30cm ×10 cm spacing performed best in respect of seed yield (1.58 t ha^{-1}).

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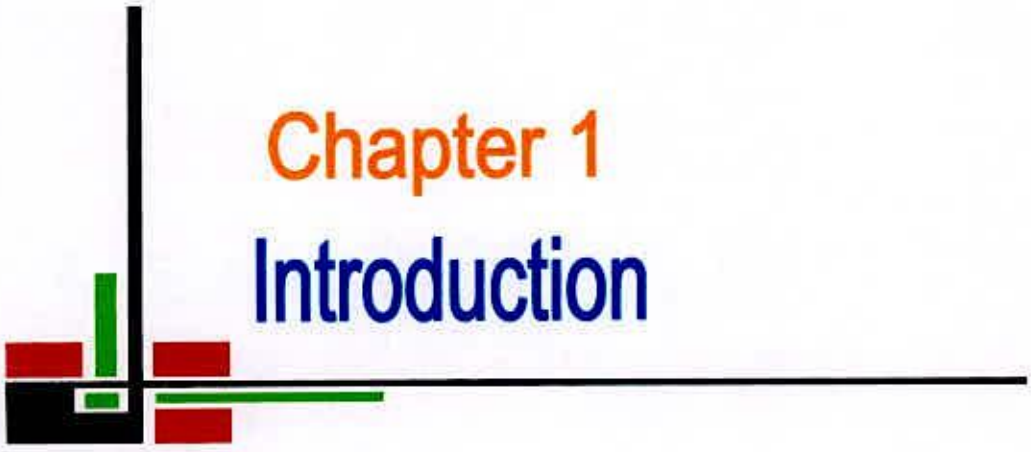
LIST OF ABBREVIATIONS

BARI	=	Bangladesh Agricultural Research Institute
CBR	=	Cost Benefit Ratio
cm	=	Centimeter
^{0}C	=	Degree Centigrade
DAS	=	Days after sowing
et al.	=	and others *(at elli)*
Kg	=	Kilogram
Kg/ha	=	Kilogram/hectare
g	=	gram (s)
LER	=	Land Equivalent Ratio
LSD	=	Least Significant Difference
MP	=	Muriate of Potash
m	=	Meter
P^H	=	Hydrogen ion conc.
RCBD	=	Randomized Complete Block Design
TSP	=	Triple Super Phosphate
t/ha	=	ton/hectare
%	=	Percent



Chapter 1

Introduction

Chapter 1

INTRODUCTION

Blackgram is one of the most important pulse crops in Bangladesh. It has good digestibility, flavor and high protein content. Being a short duration crop it fits well into the intensive cropping system. Pulse crops belong to grain legume. Bangladesh grows various types of pulse crops among them lentil, chickpea, blackgram, mungbean, fieldpea grasspea and cowpea are important. These crops provide valuable protein in our human diet.

Pulse protein is rich in lysine that is deficient in rice. According to FAO (1999) recommendation, a minimum intake of pulse by a human should be 80 g/day, where as it is 7.92 g in Bangladesh (BBS, 2002). This is because of fact that national production of the pulses is not adequate to meet our national demand. Both the acreage and production of the pulses are decreasing in Bangladesh day by day due to the inception of maize wheat and boro rice in our cropping system with irrigation facilities.

The area under pulse crop is 0.406 million hectare with a production of 0.322 million tone (BBS, 2005), where blackgram is cultivated in the area of 0.188 million ha with production of 9.5% of total pulse production (BBS, 2005). In respect of total land area and total production, blackgram has occupied 4th position of all pulses (BARI, 2005).

Among the pulse crops, blackgram has a special importance in intensive crop production system of the country for its short growing period (Ahmed *et al.*, 1978). In Bangladesh, it can be grown in late winter and summer

season. Summer blackgram can tolerate a high temperature exceeding 40^0C and grows well in the temperature range of 25 - 34 ^{0}C. This crop is also reported to be drought tolerant and can also be cultivated in areas of low rainfall, but also grows well in areas with 750 - 900 mm rainfall (Kay, 1979). So, cultivation of blackgram in the summer season could be an effective effort to increase pulse production in Bangladesh.

In Bangladesh, blackgram ranks fourth in acreage and production but ranks second in market price. Blackgram grain contains 48.0% carbohydrate, 22.23% protein, 154 mg calcium, 9.1mg iron, 1.4 g fat, 0.37 g riboflavin and 0.42 mg thiamin per 100 g blackgram (BARI, 1999). The green plants can also be used as animal feed and the residues as manure. The crop is potentially useful in improving cropping system as it can be grown as a catch crop due to its rapid growth and early maturing characteristics. It can also fix atmospheric nitrogen through the symbiotic relationship between the host blackgram roots and soil bacteria and thus improves soil fertility.

The average yield of blackgram is 1.4 – 1.5 t ha^{-1} (BARI, 2005). There are many reasons of lower yield of blackgram of which very much weed infestation and lack of optimum plant density; weed is one of the most important factors responsible for low yield (Islam *et al.*, 1989). Blackgram is not very competitive against weed and therefore weed control is essential for it's production (Moody, 1978). Yield losses due to uncontrolled weed growth in blackgram ranges from 27 to 100% (Madrid and Vega, 1971).

Plant density is one of the most important factors which can be manipulated to maximize yield (Babu and Mitra, 1989). Plant density plays an important role in the dominance and suppression during the process of competition of two or more species having similar life forms (Hashem, 1991). Ahmed *et al.* (1982) obtained greater yield of blackgram at higher density grown during early kharif. Information of the effect of blackgram plant density on competition with weed grown during late kharif is lacking in Bangladesh.

All crops have a stage during their life cycle when are particularly sensitive to weed competition. In general, it ranges up to first 25 to 50% of the life time of crops. Critical time of weed competition is the range within which a crop must be weeded to save the crop from damages of weeds (Islam *et al.*, 1989). The critical period of weed competition in blackgram and time of weed control for maximum yield is very important to know because of higher yield.

The most sensitive period for weed control was between 3 and 6 weeks after planting. Weeding before or after this period did not increase yields significantly. Unweeded plots had a yield loss of up to 90% compared to weed-free fields. Competition by weeds influenced established plant density and number of pods per plant rather than 100-seed weight (Meylemans *et al.*, 1994).

The rate of dry matter production in many crops is proportional to the intercepted radiation. The growth of crop is, therefore, often analyzed in term of intercepted radiation and the efficiency of conversion of solar radiation to dry weight (Gallagher *et.al*, 1978). However such relationship may be changed for a crop which is in competition with weed for solar

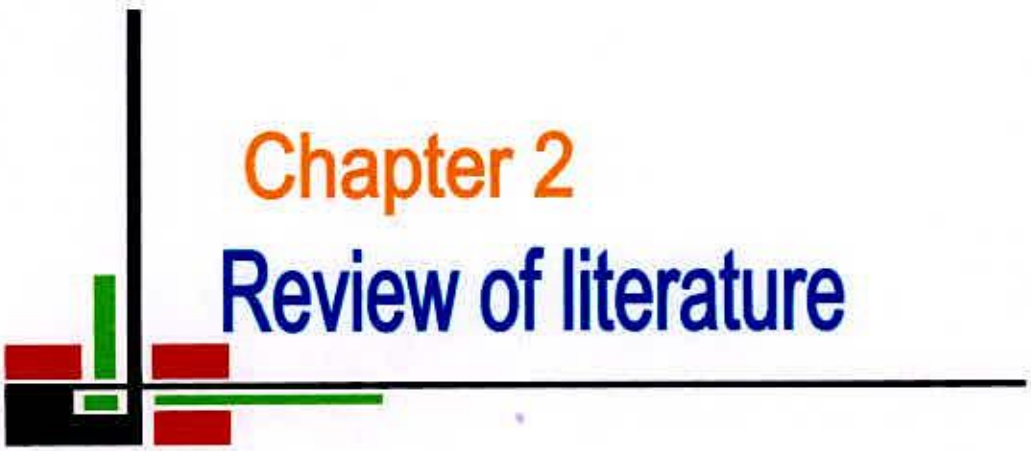
radiation/ the development of leaf area of blackgram may be modified by competition with weeds.

Therefore, the experiment was conducted with the following objectives:

1) To find out suitable time of weeding for higher yield of blackgram,

2) To evaluate the effect of plant density on the yield and yield attributes of blackgram, and

3) To determine the influence of combine effect of time of weeding and spacing on the yield performance of blackgram.



Chapter 2

Review of literature

Chapter 2

REVIEW OF LITERATURE

Many studies addressed the effect of plant density or seed rate and time of weeding on the performance of blackgram (*Vigna mungo*) and other crops. Results of such studies indicate that plant population density or seed rate application to the field and weed interference have profound influence on yield, yield attributes and biomass yields of crops. Some of the works that are relevant to the present study are reviewed here.

2.1 Time of weed control

Malik *et al.* (2003) conducted an experiment to determine the effect of varying levels of weeding (0, 1 and 2 weeding) on the yield and quality of blackgram. They observed that number of flowers plant^{-1} and pods plant^{-1} was found to be significantly higher by two times of weeding.

Mahla *et al.* (1999) conducted an experiment on weeding effect at 20, 30, 40 days after sowing and no weeding. Plant height, number of branches plant^{-1}, dry matter production plant^{-1} and yield of blackgram increased with increasing weeding. Three times of weeding had the best effect on plant height, number of branches plant^{-1}, dry matter production plant^{-1}.

Kalita *et al.* (1995) reported that times of weeding (2 or 3 times) on blackgram resulted the greatest seed yield and harvest index which were reported to be associated with a greater number of pods plant^{-1} and seeds pod^{-1}.

Ahmed *et al.* (1993) found that one hand weeding at 10 or 20 DAE produced higher yield than unweeded plots in blackgram during early kharif. Although some information on the effect of weeding on yield and yield attributes are available, the effect of crop density and delay in weed removal of blackgram (duration of weed competition) on its yield and yield attributes, leaf area index (LAI), light interception, are not yet available for blackgram in agro-ecological conditions of Bangladesh.

Ahmad (1992) observed highest grain yield of mungbean when weeded at 10 DAS. Crood and Renner (1990) stated that maximum seed yield was obtained when weeds were removed 20 days after sowing. In competition study, 20% yield reduction in soyabean occurred if weed control measures was not taken prior to 5 weeks after emergence.

Bryson (1990) observed that critical period of weed competition is the minimum weed free period essential during life cycle of a crop to prevent yield loss; the critical period of weed control in interference study is the period up to which the weeds would be allowed without significant yield losses of crops.

Islam *et al.* (1989) found that every crop has a stage during its life cycle when it is particularly sensitive to weed competition.

Hamid (1988) conducted a field experiment to investigate the effect of weeding on the growth and yield performance of mungbean. He found that the plant height, dry matter production plant^{-1} and yield of mungbean were found to be increased with more weeding.

Pongkao and Inthong (1988) reported that proper weeding on blackgram was found to be superior giving 23 % higher biological yield over the control.

Kumar and Kairon (1988) found that weed biomass increased yield decreased with delay in weeding of blackgram. However, delay in weeding did not affect the number of seeds pod^{-1}. The higher percent yield reduction was recorded when the blackgram plants were exposed to longer weed competition. Dry matter was maximum under weed free condition followed by weed removal at 30 DAS.

Pascua (1988) determined the critical period of weed control and competition on mungbean yield. The treatments that gave lower fresh weight of weed had higher number of seeds pod^{-1}.

Singh *et al.* (1988) stated that higher yield of mungbean was obtained from the weeded plants compared to unweeded control.

Karim *et al.* (1986) found that critical period of weed competition was in between 20 and 30 days after sowing in jute.

Sanker and Mondal (1985) observed that weeding at different dates after sowing affected some yield contributing characters and yield of blackgram. Grain yield was reduced by 49 to 55% when weeds were not removed at all.

Variable number of weeding in blackgram have been suggested viz., one weeding at 2 weeks after emergence (Sanker and Mondal, 1985), 2 weeding during early growth stage (Madrid and Vega, 1971), and three weeding during the first 3 weeks after sowing (Enyi, 1973) for optimum yield.

Patel *et al.* (1984) studied the effect of weeding on the growth and seed yield of mungbean during summer season. They observed that two times of weeding significantly increased the 1000 seed weight of mungbean compared to control treatment.

Yadav *et al.* (1983) found that removal of weeds at 10, 20 or 30 days after sowing, produced higher yield of mungbean than weedy check.

Soyabean seeds pod^{-1}, pods $plant^{-1}$ was reduced due to long duration of wild oat competition (Rathmann and Miller, 1981).

Madrid and Manimtim, (1977) stated that yield loss due to uncontrolled weed growth in blackgram range from 27 to 100%.

Blackgram was not very competitive against weeds and therefore, weed control is essential for blackgram production (Moody, 1978).

Vats and Sidhu, (1976) stated that the magnitude of yield loss due to weed depends on environmental condition and weed growth. Yield loss of blackgram was 60% during spring and 27% during the summer in Taiwan.

Envy (1973) reported that weeding up to 8 weeks after sowing is required for optimum yield of blackgram. The yield loss of blackgram was 95% during dry season in Philippines (Madrid and Vaga, 1971).

2.2 Plant density and blackgram performance

Hassan and Baswaid (2004) obtained a result with different seed rate (30, 40 and 50 kg ha^{-1}) application on blackgram cultivation and stated that seed rate application influenced the growth and yield of blackgram. The seed rate (40 kg ha^{-1}) was expressed as optimum increase in plant length, leaf area and yield.

Ganiger *et al.* (2003) investigated the effect of seed rate on the growth and yield of cowpea. Different seed rate (30, 40, 50, 60 kg ha^{-1}) showed different yield and harvest index and optimum seed rate (50 kg ha^{-1}) ensure higher yield and higher harvest index.

Srinivas *et al.* (2002) conducted an experiment on the performance of soyabean at different seed rate levels. They observed that 1000 seed weight was generally decreased with higher density of plant population.

Mahboob and Asghar (2002) studied the effect of seed rate at different levels on blackgram at the Agronomic Research Station, Farooqabad in Pakistan. They revealed that biological yield and seed yield were greatly influenced by seed rate.

Bachchhav *et al.* (1994) stated that lower seed rate increased the number of green leaves, branches and dry matter accumulation in mungbean plants.

Plant density mainly depends on seed rate application of blackgram. Plant density in respect of seed rate application is the most important yield contributing character which can maximize yield (Babu and Mitra, 1989).

Hamid (1989) found that blackgram grown at very high density with the application of high seed rate failed to produce yield because of high rate of mortality. Dry matter yield plant^{-1} decreased progressively with increasing density. Grain yield plant^{-1} decreased with increasing seed rate application that cause plant density but the yield density function constructed based on grain yield unit^{-1} area followed a quadratic relationship.

Plant density is achieved by seed rate and/or varying row spacing. Seed yield of soyabean was significantly higher with high population in narrow rows than in the wide rows (Ethredge *et al.*, 1989).

Arya and Kalra (1988) found that grain yield plant^{-1} decreased with increasing seed rate application but not suitable for the yield plant^{-1} incase of more plant density.

Panwar and Sirohi (1987) reported that yield ha^{-1} and number of seeds pod^{-1} increased with increasing plant density through increased seed rate application to the field whereas yield plant^{-1} and number of pods plant^{-1} decreased with increasing plant density in mungbean

Radosevieh, (1987) stated that seed rate has considerable effect on the suppression of weeds. Seed rate or plant density, species proportion and spatial arrangements are important considerations that mediate the influence of environmental and biological factors

Increase in the plant density of increased seed rate application of crops was expected to suppress weed growth (Radosevieh (1987) and Martin *et al.* 1987). Moody, (1978) reported that the use of crop to compete against weeds and suppress them was a weed control technique that was often overlooked.

Ahmed (1986) found that 50 plants m^{-2} of blackgram gave higher yield than 33 plants m^{-2} in early kharif season.

Brathwaite, (1982) reported from an experiment that high yield of good quality pod can be obtained from increased plant density and weed free environment in *Vigna unguiculata.*

Increasing seed rate application that caused increased plant density resulted in plants bearing less pod and seed in *Vicia faba* L. (Zahab *et al.*, 1981).

The yield of blackgram did not increased linearly with increase in density as it did in soyabean. The number of pods plant^{-1} of blackgram decreased as density increased (if high seed rate was applied and thining was not done) unlike soyabean (Mackenzie, 1977).

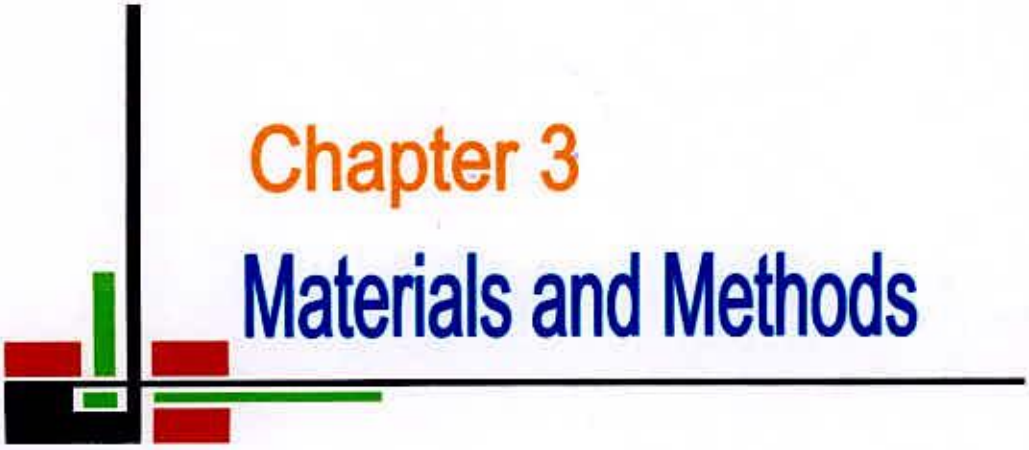
In an experiment, Yein *et al.* (1981) applied different seed rates to blackgram and reported that gradually increased seed rate caused gradually decreased number of flowers plant^{-1}, pod plant^{-1} and dry weight plant^{-1}.

One approach of elevating the seed yield of mungbean by Asian Vegetable Research and Development Centre (AVRDC) was to increase yield by increasing seed rate application (Mackenzie *et al.*, 1975).

2.3 Effect of weeding and plant density

Asheesh and Elamathi (2007) conducted an experiment to evaluate the effect of plant spacing (25cm x10cm , 30cm x10cm , 25cm x15cm and 30cm x15 cm) and number of weeding (control, one weeding, two weeding and three weeding) on the yield attributes, yield and economics of mungbean with recommended fertilizer dose during the kharif season of 2005. The maximum plant height, number of leaves, number of branches plant^{-1}, dry weight plant^{-1}, pod number, grain number pod^{-1}, grain yield, economic yield and stover yield were obtained under the spacing 30 cmx 10 cm with three weeding.

Srinivas *et al.* (2002) studied the effect of weeding (4 levels; no weeding, weeding at 15, 25, 35 and 45 DAS) and seed rate (4 levels 35, 45, 55 and 65 kg ha^{-1}) on the growth and yield components of mungbean. They observed that number of leaves $plant^{-1}$, dry weight, pod length, 1000 seed weight and grain yield was increased by the seed rate of 45 kg ha^{-1} with 4 times of weeding.



Chapter 3

Materials and Methods

Chapter 3

MATERIALS AND METHODS

In this chapter, the details of different materials used and methodology followed during the experimental period are described.

3.1 Experimental site

The research work was carried out at the experimental field of Sher-e-Bangla Agricultural University, Dhaka during the period from 31 March 2007 to 8 June 2007. The field was located at the southeast part of the main academic building. The soil of the experimental plot belongs to the agro ecological zone of Madhupur Tract (AEZ-28).

3.2 Soil

A soil sample from 0 -15 cm depth was collected from experimental field. The physio-chemical properties of the soil are presented in Appendix I.

3.3 Climate

The experimental area was under the subtropical climate. Usually the rainfall was heavy during Kharif season and scanty in Rabi season. The atmospheric temperature increased as the growing period proceeded towards kharif season. The weather conditions of crop growth period such as monthly mean rainfall (mm), mean temperature (^{o}C), sunshine hours and humidity (%) are presented in Appendix II.

3.4 Planting material

The variety of blackgram used for the present study was BARI mash-1. The seeds of this variety were collected from the Pulse Research Centre of Bangladesh Agricultural Research Institute (BARI), Gazipur. Before sowing, the seeds were tested for germination in the laboratory and the percentage of germination was found to be over 90%. The important characteristics of the variety is mentioned below:

3.4.1 BARI mash-1 (Pantho)

Plants are of average 32-36 cm height. Leaves are darker green .The variety is moderately resistant to yellow mosaic virus. Maximum yield is 1.40 - 1.50 t ha^{-1}. The duration of this crop is 65-70 days. The color of the seed is blackish brown. Seeds contain 21 - 23% protein. The variety was introduced in our country in 1990.

3.5 Land preparation

The land was first opened with the tractor drawn disc plough. Ploughed soil was then brought into desirable fine tilth by 4 operations of ploughing and harrowing with country plough and ladder. The stubble and weeds were removed. The first ploughing and the final land preparation were done on 23 March and 29 March 2007, respectively. Experimental land was divided into unit plots following the design of experiment. The plots were spaded one day before planting and the basal dose of fertilizers was incorporated thoroughly before planting.

3.6 Fertilizer application

Urea, triple super phosphate (TSP) and muriate of potash (MP) were used as source of nitrogen, phosphorus and potassium, respectively.

The recommended dose of fertilizers was given below:

Cow dung	:	8000 kg ha^{-1}
Urea	:	45 kg ha^{-1}
TSP	:	80 kg ha^{-1}
MP	:	35 kg ha^{-1}

Whole amount of all fertilizers were applied at the time of final land preparation.

3.7 Treatments of the experiment

The experiment was two factorials with three levels of weeding and four levels of spacing.

Factor A: Number of weeding (W) - 3

The following weeding levels were imposed in the experiment;

i.	No weeding	(W_0)
ii.	One weeding at 25 DAS	(W_1)
iii.	Two weeding at 25 and 40 DAS	(W_2)

Factor B: Spacing (D) - 4

The following spacing levels were imposed in the experiment

i	30 cm × 7 cm	(D_1)
ii.	30 cm × 10 cm	(D_2)
iii.	30 cm × 13 cm	(D_3)
iv.	30 cm × 16 cm	(D_4)

Combining two factors, 12 treatment combinations were obtained-

i. W_0D_1	v.W_1D_1	ix.W_2D_1
ii. W_0D_2	vi.W_1D_2	x. W_2D_2
iii.W_0D_3	vii.W_1D_3	xi. W_2D_3
iv.W_0D_4	viii.W_1D_4	xii.W_2D_4

3.8 Experimental design and layout

The experiment was laid out in a Randomized Complete Block Design (RCBD) (factorial). Each treatment was replicated three times. The size of unit plot was 4 m x 2 m. The distance between two adjacent replications (block) was 1m and plot to plot distance was 0.5 m. The inter block and inter plot spaces were used as footpath and irrigation/drainage channels.

3.9 Germination test

Germination test was performed before sowing the seeds in the field using petridishes. Three layers of filter paper were placed on petridishes and the filter papers were softened with water. Seeds were distributed at random in four petridishes. Each petridish contained 100 seeds. Germination percentage was calculated by using the following formula:

$$\text{Germination (\%)} = \frac{\text{Number of germinated seeds}}{\text{Number of seeds sett for germination}} \times 100$$

3.10 Sowing of seeds in the field

The seeds of blackgram were sown in rows made by hand plough on March 31, 2007. The seeds were sown in solid rows in the furrows having a depth of 2-3 cm from the soil surface. Row to row distance was 30 cm and plant to plant distance was according to the treatments.

3.11 Intercultural operations

3.11.1 Weeding

The crop field was weeded or not weeded according to the treatment. First weeding was done at 25 DAS (Days after sowing) and second weeding at 40 DAS. Three levels of weeding were owed during the experiment according to the treatment of the design; (i) no weeding, (ii) one weeding and (iii) two weedings. Demarcation boundaries and drainage channels were also kept weed free.

3.11.2 Thinning

Thinning was done in all the unit plots with care so as to maintain the plant spacing as per treatment in each plot. Thinning was done at 10 DAS.

3.11.3 Irrigation

Pre sowing irrigation was done to maintain equal germination. After sowing two irrigations were done during the life cycle. First irrigation and second irrigation were done at 15 DAS and 30 DAS respectively.

3.11.4 Protection against insect and pest

At early stage of growth, few worms (*Agrotis ipsylon*) and virus vectors (Jassid) attacked the young plants. To control these pests, Dimacron 50 EC was sprayed at the rate of 1litre ha^{-1}. Spraying was done in the afternoon while the pollinating bees were away from the field.

3.12 Harvesting and threshing

Harvesting was done when leaves and stem of blackgram became yellowish in color and 90% of the pods became brown to black in color. The matured pods were collected by hand picking from a pre demarcated area of 3 m^2 at the centre of each plot. The harvested plants were tied into bundles and carried to the threshing floor. The crops were sun dried by spreading on the threshing floor. The seeds were separated from the pods by beating with bamboo sticks and later were cleaned, dried and weighed. The weights of the dry straw were also taken.

3.13 Crop sampling and data collection

The first crop sampling was done at 30 DAS and it continued at an interval of 15 days, viz. 45 and 60 DAS. At each harvest, ten plants were selected randomly from each plot. The selected plants of each plot were cut carefully at the soil surface level. The heights, number of leaves, pods and number of seeds pod^{-1} were recorded separately. The components were oven dried at 70°C for 72 hours to record constant dry weights. Total dry matter was determined by recording the dry weight of each portion of the plants.

3.14 Data collection

The data on the following parameters of ten plants were recorded at each harvest.

A. Growth characters

1) Plant height at 30, 45 and 60 DAS
2) Number of leaves plant^{-1}
3) Dry matter weight plant^{-1} (g)

B. Yield contributing characters

1) Number of flowers plant^{-1}
2) Number of pods plant^{-1}
3) Number of seeds pod^{-1}
4) 1000 seed weight (g)

C. Yield and harvest index

1) Yield plant^{-1}
2) Seed yield (t ha $^{-1}$)
3) Stover yield (t ha $^{-1}$)
4) Biological yield (t ha $^{-1}$)
5) Harvest index (%)

3.15 Procedure of data collection

3.15.1 Plant height

The heights of five plants were measured with a meter scale from the ground level to the top of the plants and the mean height was expressed in cm.

3.15.2 Number of leaves plant^{-1}

The leaves were separated from each sampled plant and counted and then averaged to express at per plant.

3.15.3 Dry matter weight plant^{-1}

For measuring the dry matter weight plant^{-1}, the parts of the plants were separated and then dried in oven at 60 ^{0}C for 72 hours and weight was taken carefully. The weight of separated parts was taken separately. The sum of the plant parts constituted the total dry matter of a single plant.

3.15.4 Number of flowers plant^{-1}

Number of total flowers of five plants from each plot was counted and the mean number was expressed on per plant basis.

3.15.5 Number of pods plant^{-1}

Number of total pods of pre selected five plants from each unit plot was noted and the mean number was recorded. The mean number was expressed on per plant basis.

3.15.6 Numbers of seeds pod^{-1}

The number of grains was collected from ten randomly selected pods per unit plot at the harvest and the mean number was recorded. The mean number was expressed on seeds pod^{-1}.

3.15.7 Weight of 1000 seeds

One thousand cleaned dried seeds were counted randomly from each harvest sample and weighed by using a digital electric balance and the mean weight was expressed in gram.

3.15.8 Seed yield (t ha^{-1})

Weight of seed of the demarcated area (3 m^2) at the centre of each plot was taken and then converted to the yield in t ha^{-1}.

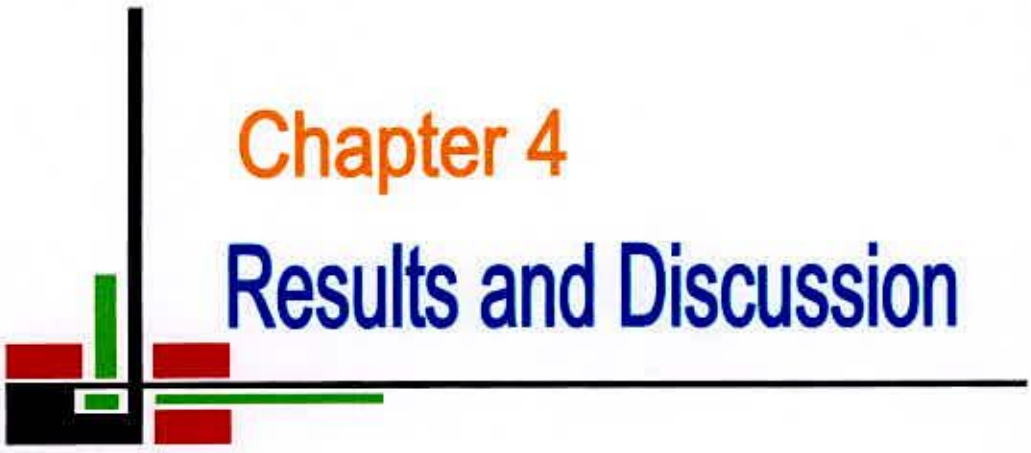
3.15.9 Harvest index (%)

The harvest index was calculated on the ratio of grain yield to biological yield and expressed in terms of percentage. It was calculated by using the following formula,

$$\text{Harvest index (\%)} = \frac{\text{Grain yield}}{\text{Biological yield}} \times 100$$

3.16 Analysis of data

The data collected on different parameters were statistically analyzed to obtain the level of significance using the MSTAT-computer package program developed by Russel (1986). After that 5% level of significance (Gomez and Gomez, 1984) was used to compare the mean differences among the treatments following DMRT method.



Chapter 4

Results and Discussion

CHAPTER 4

Results and Discussion

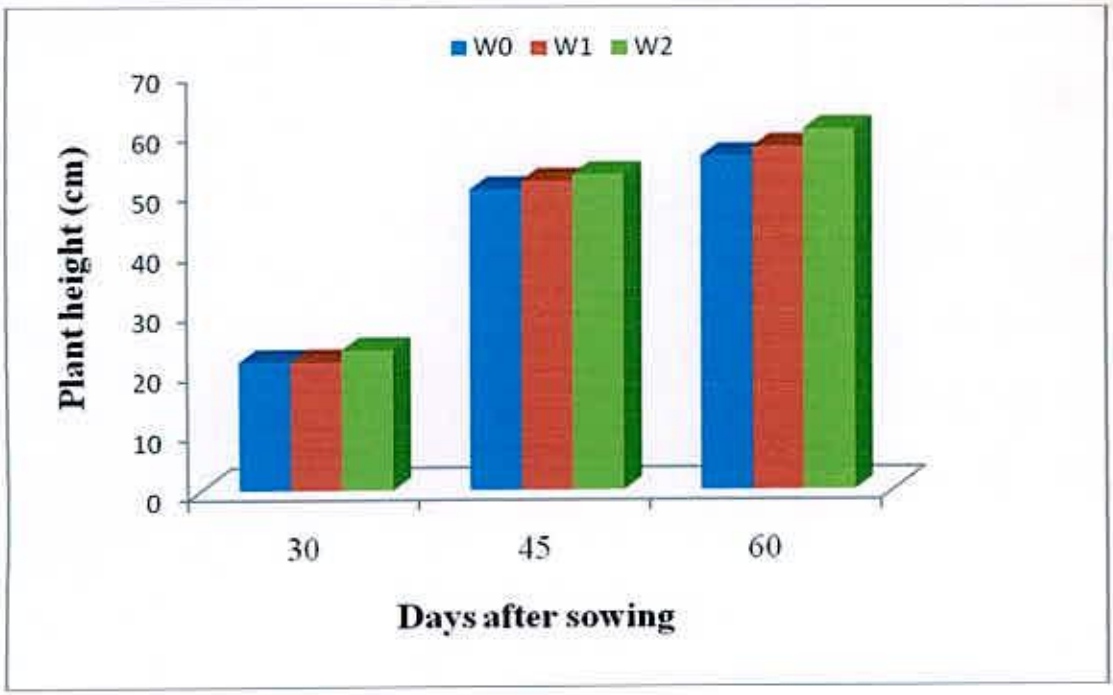
Present experiment was conducted with different levels of spacing and different times of weeding. The results regarding the effect of spacing and times of weeding and their interactions on different growth and yield parameters are presented and discussed in this chapter.

4.1 Response of growth characters of blackgram

4.1.1 Plant height

4.1.1.1 Effect of weeding

Plant height is one of the most important growth characteristics of blackgram. The result showed that the effect of weeding on plant height was significant at 30 and 45 and 60 DAS (Fig. 1). It was observed that two times of weeding always gave the highest plant height (23.47, 52.69, 60.29 cm at 30, 45 and 60 DAS, respectively) and no weeding showed the lowest height (21.44 cm) at 30 DAS which was similar with one weeding effect (21.53 cm). But at 45 and 60 DAS no weeding effect was the lowest (50.21 and 55.77 cm, respectively). Similar result was obtained by Mahla *et al.* (1999) who observed that plant height of blackgram increased with increasing weeding.



W_0 = No weeding W_1 = One weeding W_2 = Two weeding

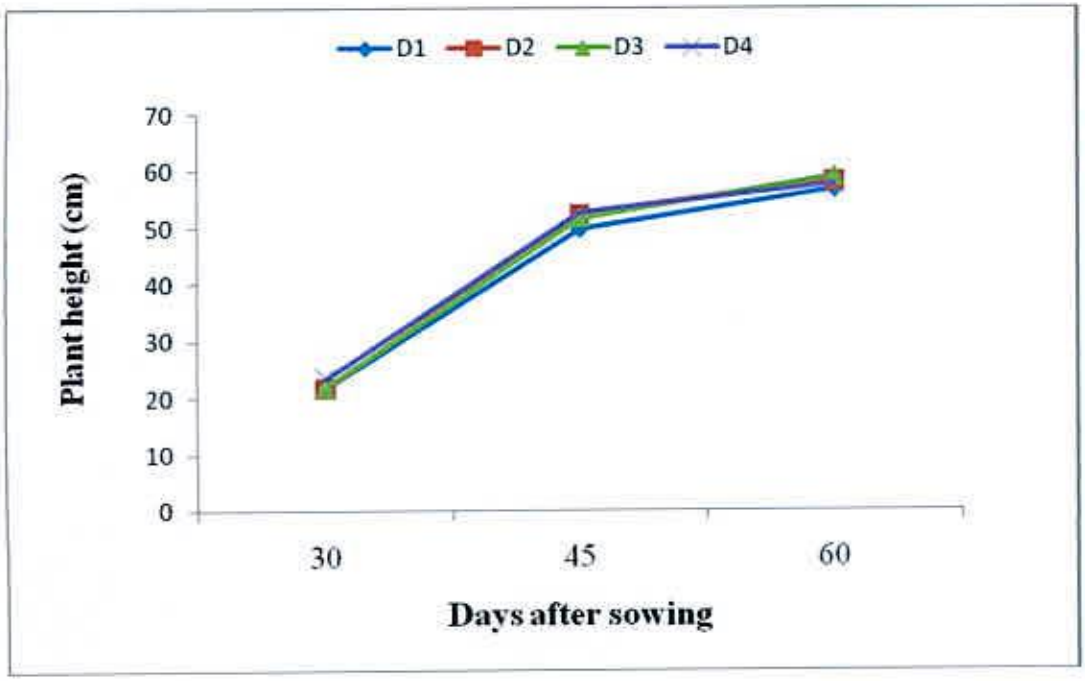
Fig. 1. Effect of weeding on plant height at different growth stages of blackgram ($S\bar{x}$ = 0.127, 0.286, 0.154 at 30, 45 and 60 DAS respectively)

4.1.1.2 Effect of different spacing

The plant height was significantly influenced by different types of spacing. At 30 and 45 DAS treatment, D_4 and at 60 DAS treatment D_3 gave the highest plant height (23.37, 52.45 and 58.98 cm, respectively). The D_1 gave the lowest plant height (21.75, 49.69 and 56.65 cm, respectively). At 30 and 45 DAS treatment, D_2 and D_3 gave the similar result with D_1 and D_2 respectively (21.62, 21.86 and 52.37, 51.61 cm, respectively). But at 60 DAS treatment, D_2 (58.14 cm) and D_4

(57.46 cm) gave the result which was significantly different from D_1 and D_3 (Fig. 2).

Similar result was found by Hassan and Baswaid (2004). They observed that among the three spacing (30, 40 and 50 kg ha^{-1}) of blackgram 40 kg ha^{-1} was found optimum to increase plant height.



D_1 = 30 cm×7 cm
D_2 = 30 cm×10 cm
D_3 = 30 cm×13 cm
D_4 = 30 cm×16 cm

Fig. 2. Effect of spacing on plant height at different growth stages of blackgram (Sx = 0.147, 0.33, 0.177 at 30, 45 and 60 DAS respectively)

4.1.1.3 Interaction effect of different weeding and spacing

The interaction effect was found to be significant for plant height at different DAS (Table 1). At 30 DAS, the significantly highest plant height was recorded from treatment W_2D_4 (27.11 cm). The lowest plant height at 30 DAS was obtained from W_1D_3 (19.87 cm). At 45 DAS, the significantly highest plant height was recorded from treatment W_2D_3 (55.99 cm) and the lowest plant height was obtained from treatment W_0D_3 (46.46 cm). At 60 DAS, the significantly highest plant height was recorded from treatment W_2D_4 (63.77 cm). The lowest plant height was obtained from treatment W_0D_4 (52.87 cm).

Similar result was obtained by Asheesh and Elamathi (2007) who observed that the plant spacing; 30 cm×10 cm and three times of weeding showed the maximum plant height of mungbean.

Table 1. Interaction effect of weeding and spacing on plant height at different growth stages of blackgram

Interaction (weeding × spacing)	Plant height (cm)		
	30 DAS	**45 DAS**	**60 DAS**
W_0D_1	21.34 de	49.17 fg	58.54 de
W_0D_2	21.28 de	51.28 de	55.14 g
W_0D_3	22.33 c	46.64 h	56.54 f
W_0D_4	20.82 e	53.74 b	52.87 h
W_1D_1	22.32 c	51.77 c-e	56.25 f
W_1D_2	21.75 cd	52.28 b-d	59.34 cd
W_1D_3	19.87 f	52.21 b-e	58.14 e
W_1D_4	22.18 c	50.54 ef	55.75 fg
W_2D_1	21.58 c-e	48.14 gh	55.17 g
W_2D_2	21.82 cd	53.55 bc	59.95 c
W_2D_3	23.39 b	55.99 a	62.26 b
W_2D_4	27.11 a	53.07 b-d	63.77 a
$S_{\bar{x}}$	**0.254**	**0.572**	**0.307**
CV (%)	**7.99**	**6.92**	**9.92**

W_0 = No weeding
W_1 = One weeding
W_2 = Two weeding

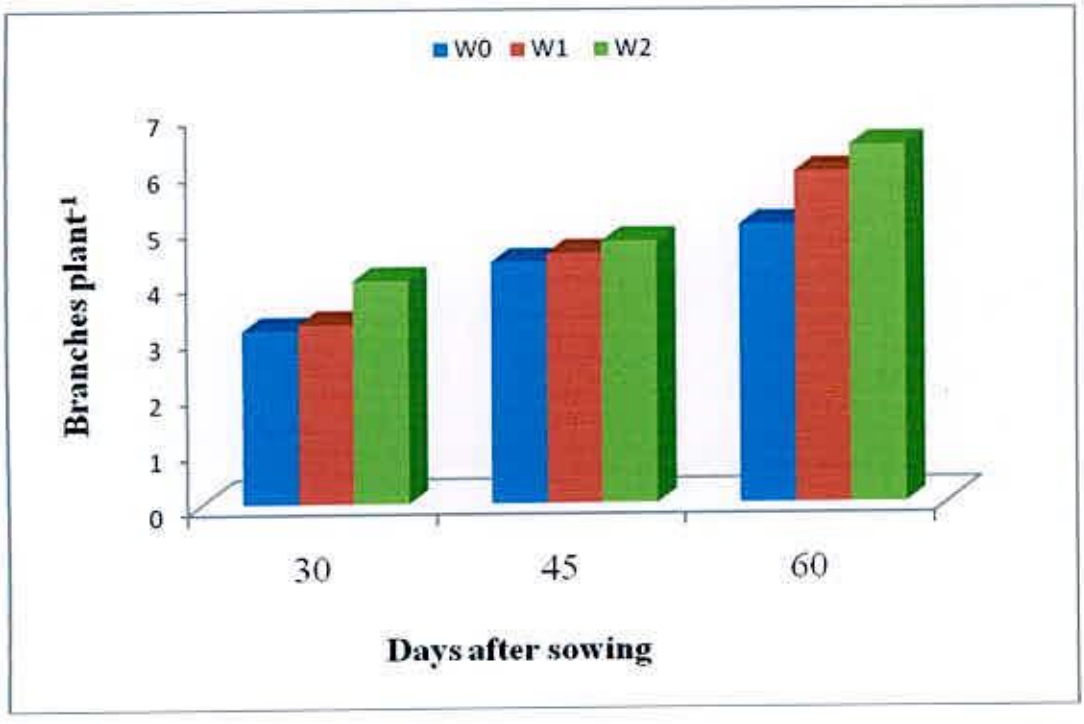
D_1 = 30cm × 7 cm
D_2 = 30cm × 10 cm
D_3 = 30cm ×13 cm
D_4 = 30cm ×16 cm

4.1.2 Number of branches plant^{-1}

4.1.2.1 Effect of weeding

Weeding had a significant effect on number of branches plant^{-1} at different growth stages of blackgram (Fig. 3). The results showed that the effect of weeding on number of branches plant^{-1} at 30, 45 and 60 DAS, two times of

weeding gave the highest number of branches plant^{-1} (4.01, 4.70 and 6.41, respectively) and no weeding showed the lowest number of branches plant^{-1} (3.12, 4.33 and 4.99, respectively). One weeding gave intermediate result at all stages which was significantly different from both no weeding and two weeding effect. The result corroborates with the findings of Mahla *et al.* (1999) who observed that number of branches plant^{-1} of blackgram increased with increasing weeding.

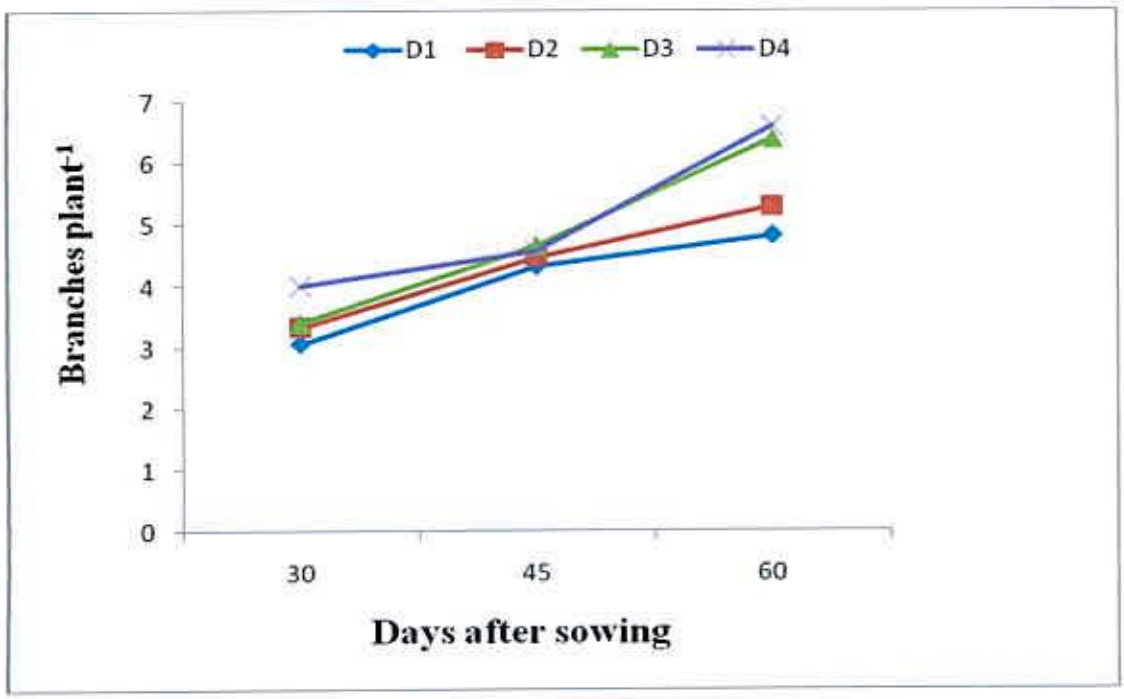


W_0 = No weeding W_1 = One weeding W_2 = Two weeding

Fig. 3. Effect of weeding on branches plant^{-1} at different growth stages of blackgram ($S_{\bar{x}}$ = 0.171, 0.152, 0.091 at 30, 45, 60 DAS after respectively)

4.1.2.2 Effect of different spacing

Effect of plant spacing on the number of branches plant^{-1} has been presented in figure 4. The figure showed that number of branches plant^{-1} increased progressively with the advances of growth stages and the highest number was found at 60 DAS for all spacing. At 60 DAS, the widest spacing D_4 gave the maximum number of branches plant^{-1} followed by D_3, D_2 and D_1. On the other hand, the widest spacing (30×16 cm) showed the highest branches plant^{-1} at all (30, 45 and 60 DAS) growth stages and the closest spacing showed the lowest for all stages. Similar result was also reported by Bachchhav *et al.* (1994).They observed that lower seed rate increased the number of branches plant^{-1} of mungbean.



D_1 = 30 cm×7 cm D_3 = 30 cm×13 cm

D_2 = 30 cm×10 cm D_4 = 30 cm ×16 cm

Fig. 4 Effect of spacing on branches plant^{-1} at different growth stages of blackgram ($S_{\bar{x}}$ = 0.032, 0.385, 0.059 at 30, 45 and 60 DAS after respectively)

4.1.2.3 Interaction effect of different weeding and spacing

The interaction effect was found to be significant for number of branches plant^{-1} at different DAS (Table 2). At 30, 45 and 60 DAS, the significantly highest number of branches plant^{-1} was recorded from treatment W_2D_4 (4.60, 5.07 and 7.70, respectively), and W_2D_3 at 45 DAS and W_1D_3 at 60 DAS gave similar result with W_2D_4. At 30, 45 and 60 DAS the lowest branches plant^{-1} was obtained from W_0D_4 (2.61, 4.20 and 5.14, respectively). The treatment combinations, W_0D_1, W_0D_2, W_0D_3, W_1D_1, W_1D_2, W_1D_4, W_2D_2 at

45 DAS and W_0D_2, W_0D_3, W_1D_1 and W_2D_1 at 60 DAS gave similar result with W_0D_4. The result was inconsistence with the findings of Asheesh and Elamathi (2007) that combination of optimum plant spacing and higher number of weeding showed maximum number of branches plant^{-1} of mungbean.

Table 2. Interaction effect of weeding and spacing on branches plant^{-1} at different growth stages of blackgram

Interaction (Weeding × spacing)	**Number branches plant^{-1}**		
	30 DAS	**45 DAS**	**60 DAS**
W_0D_1	3.347 bc	4.300 cd	3.933 f
W_0D_2	3.273 bc	4.297 cd	5.727 de
W_0D_3	3.260 bc	4.503 cd	5.197 e
W_0D_4	2.610 c	4.200 d	5.140 e
W_1D_1	3.370 bc	4.533 b-d	5.193 e
W_1D_2	3.227 bc	4.387 cd	4.187 f
W_1D_3	3.187 bc	4.623 bc	7.370 ab
W_1D_4	3.140 bc	4.443 cd	6.993 bc
W_2D_1	3.287 bc	4.597 bc	5.343 e
W_2D_2	3.337 bc	4.287 cd	5.980 d
W_2D_3	3.803 b	4.850 ab	6.607 c
W_2D_4	4.603 a	5.070 a	7.703 a
$S_{\bar{x}}$	**0.344**	**0.103**	**0.183**
CV (%)	**6.31**	**7.99**	**5.75**

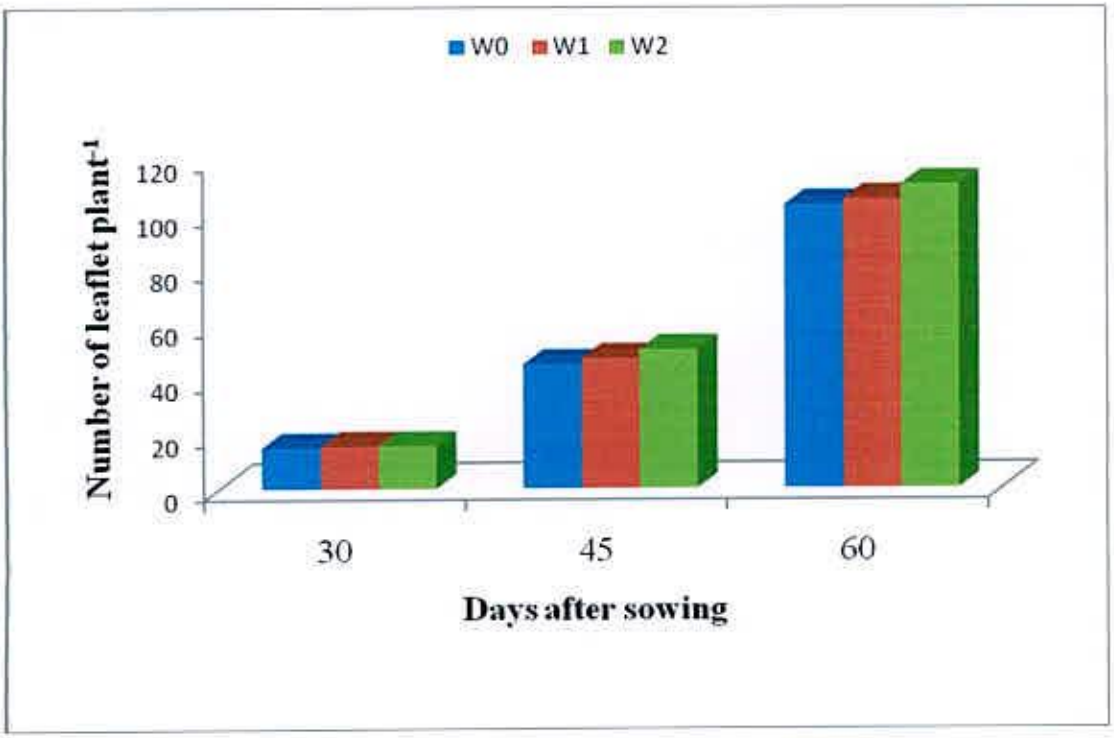
W_0 = No weeding
W_1 = One weeding
W_2 = Two weeding

D_1 = 30 cm ×7 cm
D_2 = 30 cm ×10 cm
D_3 = 30 cm ×13 cm
D_4 = 30 cm ×16 cm

4.1.3 Number of leaflet plant^{-1}

4.1.3.1 Effect of weeding

Significant variation was found in total number of leaflet plant^{-1} with different level of weeding at all growth stages (Fig. 5).The figure shows that irrespective of weedings, number of leaflet increased rapidly with the advances of growth stages. The rate of increase of leaflet plant^{-1} was much higher from 45 to 60 DAS than earlier stage. For all growth stages 30, 45 and 60 DAS two weeding treatment showed highest leaflets plant^{-1} than no or 1 weeding treatment. However at (30, 45 and 60 DAS) the number of leaflet plant^{-1} ware 15.67, 50.33 and 110.3, respectively in two is weeding treatment. The lowest number of leaflets plant^{-1} were (15.01, 45.02 and 102.90, respectively) obtained from no weeding treatment.

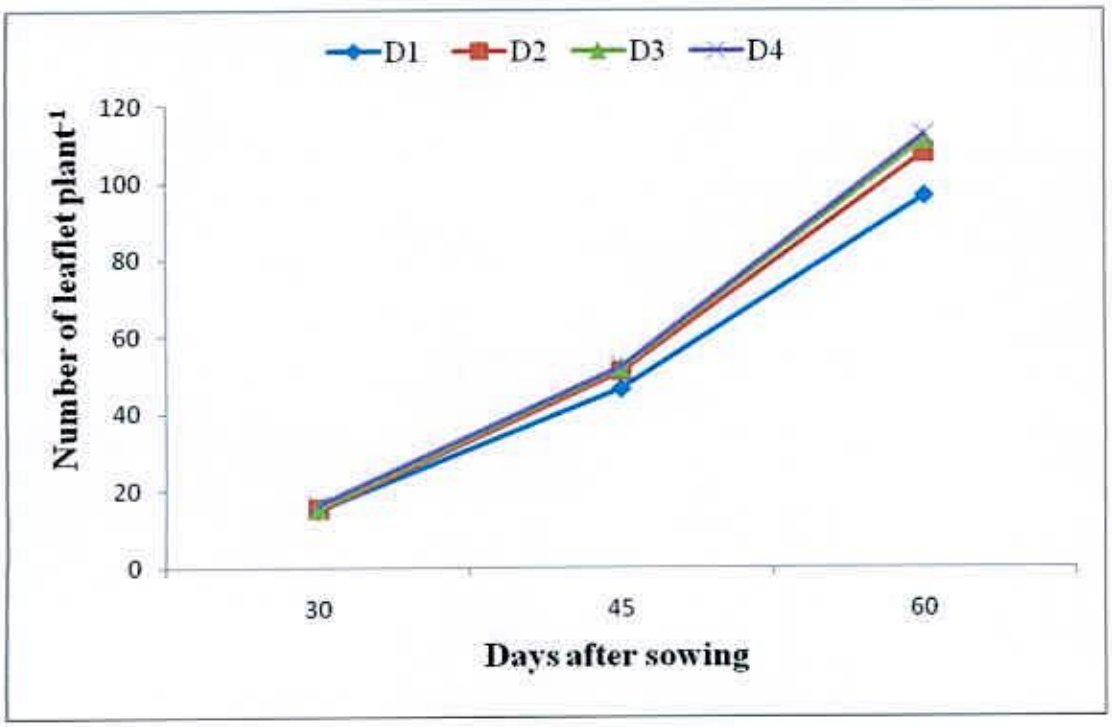


W_0 = No weeding W_1 = One weeding W_2 = Two weeding

Fig. 5. Effect of weeding on number of leaflet plant^{-1} at different growth stages of blackgram ($S_{\bar{x}}$= 0.154, 0.315, 0.994 at 30, 45 and 60 DAS after respectively)

4.1.3.2 Effect of different spacing

Effect of different spacing on number of leaflet plant^{-1} has been presented in figure 6. It appeared from the figure that leaflets plant^{-1} showed an increasing trend with increases of growth stages and plant spacing. The widest spacing (30 × 16 cm) showed highest number of leaflets plant^{-1} for all growth stages (16.26, 52.21and 112.10 for 30, 45 and 60 DAS, respectively). The closest spacing (30 × 7 cm) gave the lowest leafletss plant^{-1} 14.99, 46.25 and 96.29 respectively for 30, 45 and 60 DAS, respectively. The result agreeed with the findings of Bachchhav *et al.* (1994). They observed that lower seed rate gave higher green leaves in mungbean plants.



D_1 = 30 cm×7 cm D_3 = 30 cm ×13 cm

D_2 = 30 cm×10 cm D_4 = 30 cm ×16 cm

Fig. 6. Effect of seed rates on number of leaflets plant^{-1} at different growth stages of blackgram ($S_{\bar{x}}$= 0.178, 0.364, 1.149 at 30, 45 and 60 DAS respectively)

4.1.3.3 Interaction effect of different weeding and spacing

The interaction effect of different weeding and spacing exerted significant effect on the leaflets plant^{-1} for all growth stages (Table 3). At 30, 45 and 60 DAS maximum leaflets plant^{-1} was observed in the combination of W_2D_4 16.85, 55.14 and 118.00, respectively. At 30 DAS, the combination of W_2D_3 and W_2D_2 were similar with W_2D_2 and at 60 DAS combination of W_2D_3, W_2D_2 and W_1D_3 were statistically similar

with W_2D_4. The lowest number of leaf lets plant^{-1} was in the combination of W_0D_1 (14.50, 43.30 and 90.03, respectively) at 30, 45 and 60 DAS. The present result was confirmed by the finding of Srinivas *et al.* (2002) who observed number of leaves plant^{-1} increased by the combine effect of higher number of weeding and higher seed rate.

Table 3. Interaction effect of weeding and spacing on number of leaflet plant^{-1} at different growth stages of blackgram

Interaction (Weeding × spacing)	**Number of leaflet plant^{-1}**		
	30 DAS	**45 DAS**	**60 DAS**
W_0D_1	14.50 d	43.30 f	91.03 f
W_0D_2	15.21 cd	46.14 e	101.5 e
W_0D_3	14.88 cd	51.87 b	103.2 e
W_0D_4	15.15 cd	51.59 b	111.3 b-d
W_1D_1	14.53 cd	50.59 bc	94.08 f
W_1D_2	14.60 cd	47.96 de	105.6 de
W_1D_3	15.55 bc	51.19 bc	112.9 a-c
W_1D_4	15.40 cd	49.31 cd	107.1 c-e
W_2D_1	15.47 cd	50.45 bc	103.8 e
W_2D_2	16.45 ab	52.29 b	115.5 ab
W_2D_3	16.54 a	52.34 b	116.5 ab
W_2D_4	16.85 a	55.14 a	118.0 a
$S_{\bar{x}}$	**0.309**	**0.630**	**1.99**
CV (%)	**12.46**	**11.29**	**9.23**

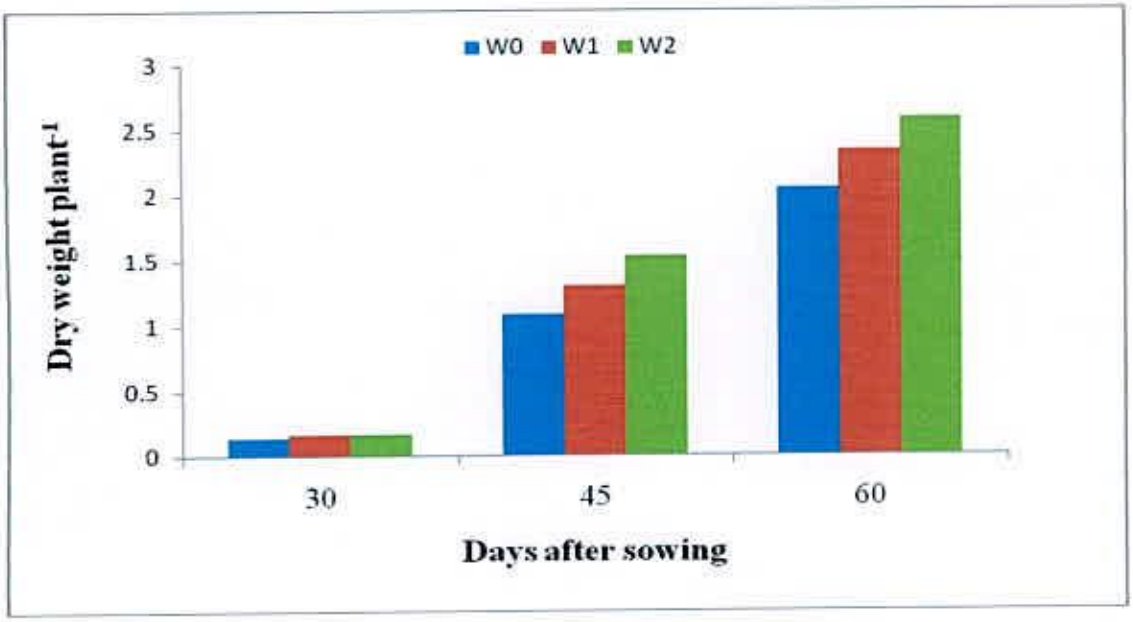
W_0 = No weeding
W_1 = One weeding
W_2 = Two weeding

D_1 = 30 cm×7 cm
D_2 = 30 cm×10 cm
D_3 = 30 cm×13 cm
D_4 = 30 cm×16 cm

4.1.4 Dry weight plant^{-1}

4.1.4.1 Effect of weeding

Significant variation was found in total dry matter plant^{-1} with different level of weeding at all growth stages except 30 DAS (Fig. 7). It was observed that total dry matter production was increased with each increment of weeding levels. It was also observed at 45 and 60 DAS the highest dry matter plant^{-1} (1.53 g and 2.583 g) and the lowest dry matter plant^{-1} (1.08 and 2.054 g) were achieved with no weeding and two weeding respectively. Mahla *et al.* (1999) obtained the similar result that dry matter production plant^{-1} of blackgram increased with increasing weeding.

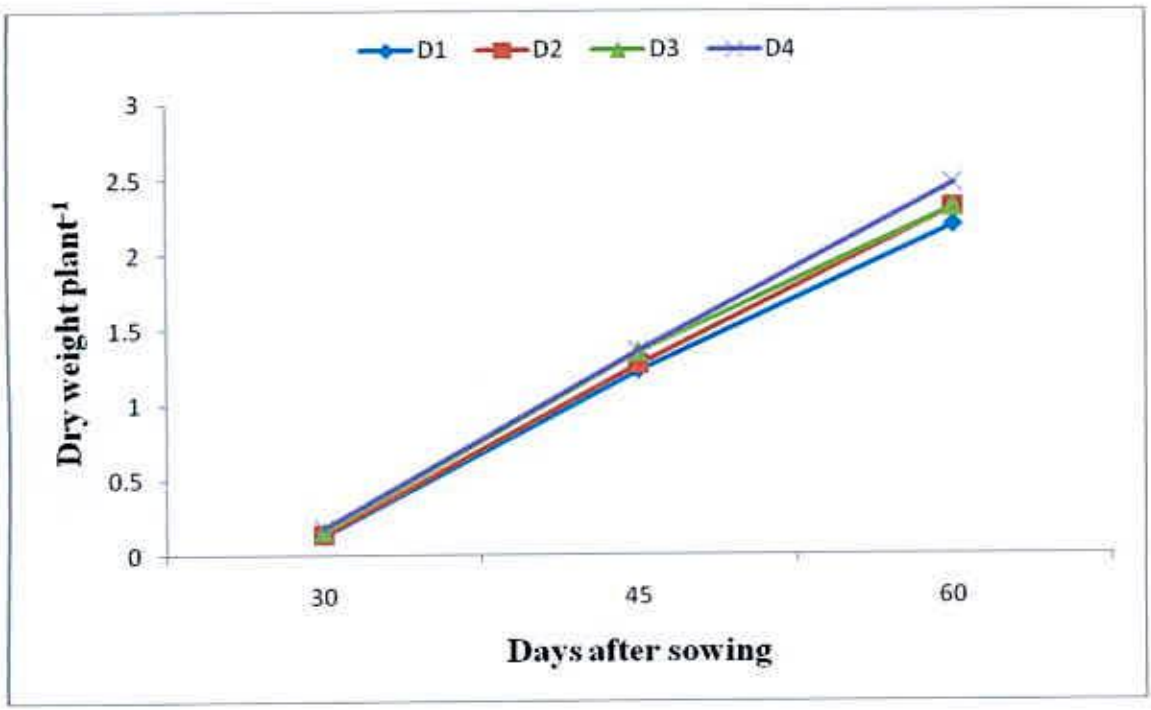


W_0 = No weeding W_1 = One weeding W_2 = Two weeding

Fig. 7. Effect of weeding on dry weight plant^{-1} at different growth stages of blackgram ($S_{\bar{x}}$ = 0.003, 0.021, 0.032 at 30, 45 and 60 DAS respectively)

4.1.4.2 Effect of different spacing

Different spacing had a significant effect on dry matter production (Fig.8) plant^{-1}except 30 DAS.The pattern of dry matter plant^{-1} showed an increasing trend with the increasing of growth stages. The widest spacing showed the highest dry matter plant^{-1}than closer spacing. The closest spacing showed lowest dry matter plant^{-1}for all growth stages. The intermediate level of dry matter plant^{-1} was obtained with the 30 cm×10cm spacing the result corroborates with findings of Hamid (1989) that dry matter yield plant^{-1} decreased progressively with increasing density.



D_1 = 30 cm×7 cm
D_2 = 30 cm×10 cm
D_3 = 30 cm×13 cm
D_4 = 30 cm×16 cm

Fig.8. Effect of spacing on dry weight plant^{-1} at different growth stages of blackgram (S_x = 0.004, 0.0.24, 0.037 at 30, 45 and 60 DAS respectively)

4.1.4.3 Interaction effect of different weeding and spacing

The interaction effect of different weeding and spacing exerted significant effect on the dry weight plant^{-1} for all growth stages except 30 DAS (Table 4). The combination W_2D_4 and W_2D_3 seem to be promising for 45 and 60 DAS for the production of higher level of dry weights plant^{-1}. At 60 DAS, the combination W_1D_4, , W_1D_3 and W_2D_2 also showed statistically similar level of dry matter plant^{-1} with W_2D_4 and W_2D_3. The combination W_0D_1 showed the lowest dry weight plant^{-1} at the same growth stage(60)DAS. Asheesh and Elamathi (2007) evaluated the effect of plant spacing (25 cm×10cm, 30cm×10cm, 25cm×15cm and 30cm×15cm) and number of weeding (control, one weeding, two weeding and three weedings) on the yield attributes, yield and economics of with recommended fertilizer dose during the kharif season of 2005.

Table 4. Interaction effect of weeding and spacing on dry weight plant^{-1} at different growth stages of blackgram

Interaction (weeding × spacing)	**Dry weight plant^{-1} (g)**		
	30 DAS	**45 DAS**	**60 DAS**
W_0D_1	0.126	1.07 d	2.00 e
W_0D_2	0.139	0.96 d	2.02 e
W_0D_3	0.150	1.25 c	2.08 de
W_0D_4	0.143	1.24 c	2.11 de
W_1D_1	0.151	1.05 d	2.06 e
W_1D_2	0.181	1.40 b	2.27 cd
W_1D_3	0.163	1.23 c	2.53 ab
W_1D_4	0.155	1.33 bc	2.65 a
W_2D_1	0.166	1.39 b	2.37 bc
W_2D_2	0.147	1.43 b	2.50 ab
W_2D_3	0.166	1.60 a	2.64 a
W_2D_4	0.178	1.71 a	2.65 a
$S_{\bar{x}}$	**0.007**	**0.041**	**0.063**
CV (%)	**7.52**	**5.19**	**6.68**

W_0 = No weeding
W_1 = One weeding
W_2 = Two weeding

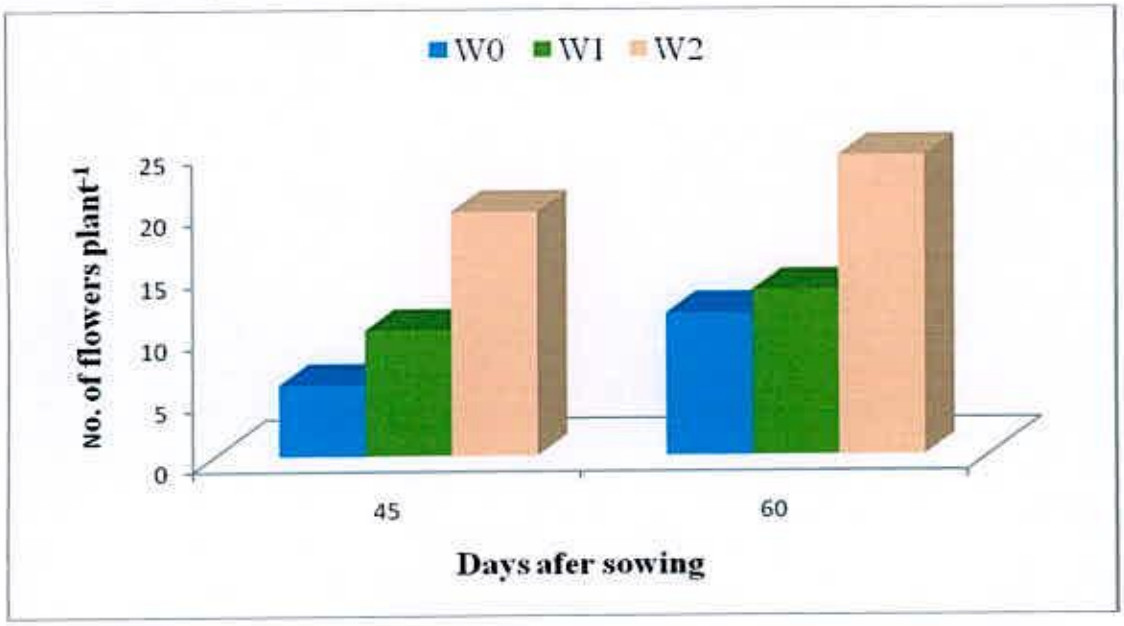
D_1 = 30 cm×7 cm
D_2 = 30 cm×10 cm
D_3 = 30 cm×13 cm
D_4 = 30 cm×16 cm

4.2 Response of yield contributing characters of blackgram

4.2.1 Number of flowers plant^{-1}

4.2.1.1 Effect of weeding

Significant variation was found in number of flowers plant^{-1} with different level of weeding at different growth stages (Figure 9). At 45 and 60 DAS the highest number of flowers plant^{-1} was 19.74 and 24.22 respectively and the lowest was 5.84 and 11.52, respectively that were recorded with two weeding and no weeding respectively and one weeding gave the medium result (10.23 and 13.38 flowers plant^{-1}). The result agreed with the findings of Malik *et al.* (2003) where the number of flowers plant^{-1} was significant due to weeding treatments.

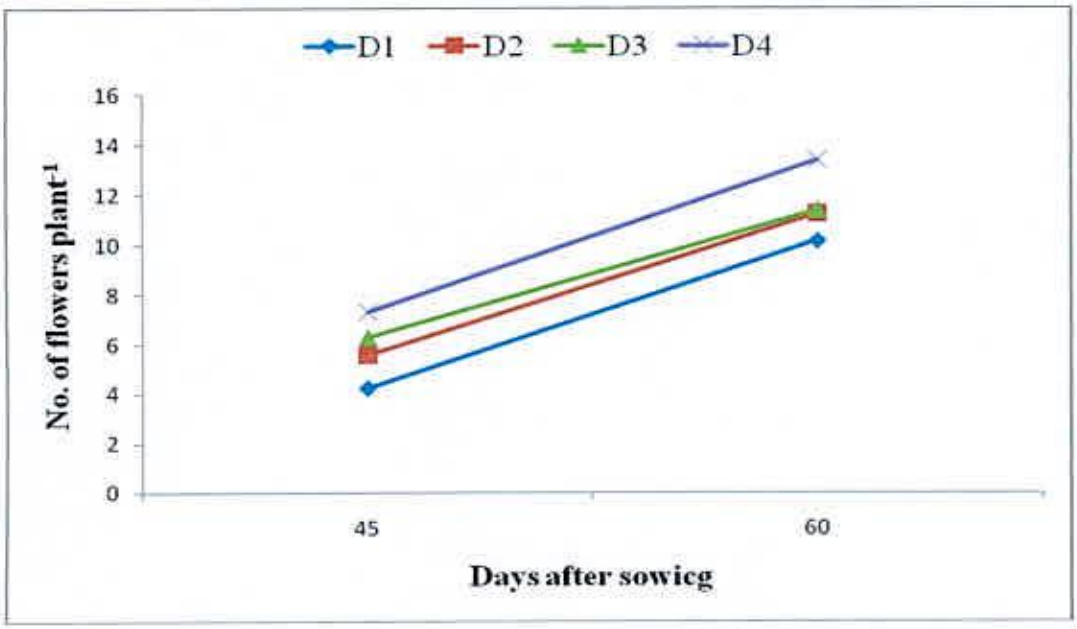


W_0 = No weeding W_1 = One weeding W_2 = Two weeding

Fig.9. Effect of weeding on number of flowers plant^{-1} at different growth stages of blackgram ($S_{\bar{x}}$ = 0.146, 0.299 at 30, 45 and 60 DAS respectively

4.2.1.2 Effect of spacing

Effect of spacing on the number of flowers plant^{-1}has been presented in figure 10. The figure showd that the widest spacing produced the highest number of flowers plant^{-1}for both the growth stages 45and 60DAS .The closest spacing showed the lowest number of flowers plant^{-1}for both the stage (45 and 60 DAS).It could be evidenced from the figure that irrespective of spacing number of flowers plant^{-1} increased straightly from 45to 60 DAS. The intermediate two spacing (D_2 and D_3) showed medium number of flowers plant^{-1} for all stages Similar result was reported by Yein *et al.* (1981) in blackgram where increased spacing caused gradually decreased the number of flowers plant^{-1}.



D_1 = 30 cm×7 cm D_3 = 30 cm ×13 cm

D_2 = 30 cm×10 cm D_4 = 30 cm×16 cm

Fig. 10. Effect of spacing on number of flowers plant^{-1}at different growth stages of blackgram ($S_{\bar{x}}$ = 0.168, 0.345 respectively at 30, 45 and 60 DAS)

4.2.1.3 Interaction effect of different weeding and spacing

The interaction effect was found significant for number of flowers plant^{-1} at different DAS (Table 5). The combination W_2D_4 (2 weeding and 30×16cm spacing) showed it's superiority by producing highest number of flowers plant^{-1} for both the sampling dates (45 and 60 DAS). At 60DAS the combination W_2D_4 (2 weddings and 30 cm×7 cm spacing) should similar result with W_2D_1 combination. In general, no wedding with all spacing treatment showed lower label of flowers plant^{-1}than other combination.However,at 45 DAS, W_0D_4 combination and at 60 DAS W_0D_1 combination should the lowest number of flowers plant^{-1}

Table 5. Interaction effect of weeding and spacing on number of flowers plant^{-1} at different growth stages of blackgram

Interaction (Weeding×Spacing)	Number of flowers plant^{-1}	
	45 DAS	**60 DAS**
W_0D_1	6.277 h	10.14 f
W_0D_2	7.300 g	11.08 f
W_0D_3	5.560 h	11.23 f
W_0D_4	4.220 i	11.36 f
W_1D_1	10.38 ef	11.87 ef
W_1D_2	10.85 e	16.32 c
W_1D_3	10.02 ef	13.36 de
W_1D_4	9.693 f	14.25 d
W_2D_1	20.81 b	20.28 ab
W_2D_2	18.29 c	16.47 c
W_2D_3	16.78 d	18.64 b
W_2D_4	23.07 a	21.50 a
$S_{\bar{x}}$	**0.292**	**0.597**
CV (%)	**4.23**	**7.63**

W_0 = No weeding
W_1 = One weeding
W_2 = Two weeding

D_1 = 30 cm×7 cm
D_2 = 30 cm×10 cm
D_3 = 30 cm×13 cm
D_4 = 30 cm×16 cm

4.2.2 Number of pods plant^{-1}

4.2.2.1 Effect of weeding

Weeding treatment exerted significant effect on number of pods plant^{-1} in blackgram (Table 6). Number of pods plant^{-1} increased significantly with the increased number of weeding. Two weeding produced the highest number of

pods plant^{-1} than lower number of weeding. It appeared from the result that 2 weeding showed highest pods plant^{-1}than single or no weeding treatment. Pascua (1988) determined the critical period of weed control and competition on mungbean yield. They stated that the pods plant^{-1} treatments that gave lower fresh weight of weed and higher number of seeds pod^{-1} which supported this result.

Table 6. Effect of weeding on number of pods plant^{-1} of blackgram

Weeding	**Number of pods plant^{-1}**
No weeding (W_0)	7.12c
One weeding (W_1)	10.10 b
Two weeding (W_2)	14.40 a
$S_{\bar{x}}$	**0.038**
CV (%)	**7.22**

4.2.2.2 Effect of different spacing

Different spacing of blackgram showed the significant effect on number of pods plant^{-1} (Table7). The result showed that the widest spacing showed the highest pods plant^{-1} after that the number of pods reduced significantly with the reduceds of spacing. The closest spacing showed the lowest number of pods plant^{-1}(9.16). Similar finding was viewed by Zahab *et al.* (1981) where that increased plant density resulted in plants bearing fewer pods in *Vicia faba*.

Table 7. Effect of spacing on number of pods plant^{-1} of blackgram

Spacing	Number of pods plant^{-1}
30 cm ×7 cm (D_1)	9.16 d
30 cm ×10 cm (D_2)	9.97 c
30 cm ×13 cm (D_3)	10.13 b
30 cm ×16 cm (D_4)	12.91 a
$S_{\bar{x}}$	**0.043**
CV (%)	**7.22**

4.2.2.3 Interaction effect of different weeding and spacing

The interaction effect of weeding and spacing was found to be significant for number of pods plant^{-1} (Table 8). The interaction, W_2D_4 represented the best result (18.88) and the lowest value was obtained from W_0D_1 (5.39). Treatments, W_2D_1, W_2D_2 and W_2D_3 gave comparatively higher results but significantly different from W_2D_4. Similar result was also obtained by Asheesh and Elamathi (2007 and the maximum pod number was obtained by the spacing 30×10 cm^2 with three weeding combination.

Table 8. Interaction effect of weeding and spacing on number of pods plant^{-1} of blackgram

Weeding × spacing	**Number of pods plant^{-1}**
W_0D_1	5.39 j
W_0D_2	6.66 i
W_0D_3	7.82 h
W_0D_4	8.62 g
W_1D_1	8.63 g
W_1D_2	11.22 d
W_1D_3	10.80 e
W_1D_4	9.747 f
W_2D_1	12.19 c
W_2D_2	12.33 c
W_2D_3	14.20 b
W_2D_4	18.88 a
$S_{\bar{x}}$	**0.075**
CV (%)	**7.22**

W_0 = No weeding
W_1 = One weeding
W_2 = Two weeding

D_1 = 30 cm×7 cm
D_2 = 30 cm ×10 cm
D_3 = 30 cm ×13 cm
D_4 = 30 cm ×16 cm

4.2.3 Number of seeds pod^{-1}

4.2.3.1 Effect of weeding

Seeds pod^{-1} was significantly affected by weeding effect at different levels of weeding of blackgram (Table 9). The results showed that two times of weeding gave the highest seeds pod^{-1} (7.47) followed by one weeding (7.38) and no weeding gave the lowest result (6.26 seeds pod^{-1}). Kalita *et al.* (1995) obtained the similar result that times of weeding (2 or 3 times) resulted the greatest seed yield which were associated with a greater number of pods plant^{-1} and seeds pod^{-1}.

Table 9. Effect of weeding on number of seeds pod^{-1} at different growth stages of blackgram

weeding	**Number of seeds pod^{-1}**
No weeding	6.26 b
One weeding	7.38 a
Two weeding	7.47 a
$S_{\bar{x}}$	**0.178**
CV (%)	**8.75**

4.2.3.2 Effect of different spacing

There was no significant effect of number of seeds pod^{-1} on different spacing of blackgram (Table 10). But numerically the treatment, D_4 gave the best result (7.24) and D_1 gave the lowest result (6.846).

Table 10. Effect of spacing on number of seeds pod^{-1} at different growth stages of blackgram

Spacing	Number of seeds pod^{-1}
30 cm ×7 cm(D_1)	6.846
30 cm ×10 cm (D_2)	6.939
30 cm ×13 cm (D_3)	7.121
30 cm ×16 cm (D_4)	7.240
$S_{\bar{x}}$	**0.205**
CV (%)	**8.75**

4.2.3.3 Interaction effect of different weeding and spacing

The interaction effect of weeding and spacing was found to be significant for seeds pod^{-1} (Table 11). The interaction W_2D_4 represented the best result (7.99) and followed by W_1D_4 (7.97) and W_1D_1 (7.45). The lowest value of seeds pod^{-1} was obtained from W_0D_1 (5.80) which was similar to the combination of W_0D_2 (6.24), W_0D_3(6.55), W_0D_4(6.44)and W_1D_3(6.83). Similar result was obtained by Asheesh and Elamathi (2007) and the maximum grain number pod^{-1} was achieved by the combination of spacing 30 cm×10 cm with three weeding.

Table 11. Interaction effect of weeding and spacing on number of seeds pod^{-1} at different growth stages of blackgram

Interaction (weeding × spacing)	**Number of seeds pod^{-1}**
W_0D_1	5.80 d
W_0D_2	6.24 cd
W_0D_3	6.55 b-d
W_0D_4	6.44 b-d
W_1D_1	7.45 ab
W_1D_2	7.28 a-c
W_1D_3	6.83 a-d
W_1D_4	7.97 a
W_2D_1	7.28 a-c
W_2D_2	7.30 a-c
W_2D_3	7.31 a-c
W_2D_4	7.99 a
$S_{\bar{x}}$	**0.355**
CV (%)	**8.75**

W_0 = No weeding
W_1 = One weeding
W_2 = Two weeding

D_1 = 30 cm ×7 cm
D_2 = 30 cm ×10 cm
D_3 = 30 cm ×13 cm
D_4 = 30 cm ×16 cm

4.2.4 Weight of 1000 seeds

4.2.4.1 Effect of weeding

Weight of 1000 seeds (g) was significantly affected by weeding effect at different levels of weeding of blackgram (Table 12). The results showed that 1000 seeds weight increased gradually with the increases of weeding number. Two weeding treatment showed the highest value (42.09g) of 1000 seed weight which was 1.84% and 0.98% higher than no and single weeding treatments respectively. Patel *et al.* (1984) observed similar result that two times of weeding significantly increased the 1000 seed weight of mungbean compared to control treatment.

Table 12. Effect of weeding on 1000 seed weight of blackgram

Weeding	**1000 seed weight (g)**
No weeding (W_0)	41.33 b
One weeding (W_1)	41.68 ab
Two weedings (W_2)	42.09 a
$S_{\bar{x}}$	**0.303**
CV (%)	**7.49**

4.2.4.2 Effect of different spacing

Different spacing of blackgram showed non significant effect on 1000 seed weight (Table 13). However the spacing D_4 (30 cmx16cm) gave the best result (41.81 g) and D_1(30 cm x 7cm) gave the lowest result (41.52 g) and D_2(30 cmx10cm) and D_3 (30 cmx13cm) gave the intermediate result. Similarly Srinivas *et al.* (2002) observed that 1000 seed weight was generally decreased with higher density of plant population.

Table 13. Effect of spacing on 1000 seed weight of blackgram

Spacing	**1000 seed weight(g)**
30 cm×7 cm(D_1)	41.52
30 cm×10 cm(D_2)	41.71
30 cm×13 cm(D_3)	41.75
30 cm×16 cm(D_4)	41.81
$S_{\bar{x}}$	**0.348**
CV (%)	**7.49**

4.2.4.3 Interaction effect of different weeding and spacing

The interaction effect was found to be significant for 1000 seed weight (Table 14). The interaction W_2D_4 represented the best result (42.40 g). The similar result was found with the interactions of W_1D_1, W_1D_2, W_1D_3, W_1D_4, W_2D_1, W_2D_2 and W_0D_1 comparison with W_2D_4. The interaction W_0D_1 represented the lowest result (41.30 g) and the similar result was found with the interaction of W_0D_1, W_0D_2 and W_0D_4 comparison with W_0D_1. Similar finding was found by Srinivas *et al.* (2002) where 1000 seed weight of soybean was increased by the higher seed rate of 45 kg ha^{-1} with 4 times of weeding.

Table 14. Interaction effect of weeding and spacing on 1000 seed weight of blackgram

Interaction (Weeding × Spacing)	**1000 seed weight**
W_0D_1	41.36 b
W_0D_2	41.42 b
W_0D_3	41.30 b
W_0D_4	41.23 b
W_1D_1	41.47 ab
W_1D_2	41.68 ab
W_1D_3	41.77 ab
W_1D_4	41.81 ab
W_2D_1	41.74 ab
W_2D_2	42.04 ab
W_2D_3	42.18 ab
W_2D_4	42.40 a
$S_{\bar{x}}$	**0.605**
CV (%)	**7.49**

W_0 = No weeding
W_1 = One weeding
W_2 = Two weedings

D_1 = 30 cm×7 cm
D_2 = 30 cm ×10 cm
D_3 = 30 cm×13 cm
D_4 = 30 cm×16 cm

4.3 Yield and Harvest index

4.3.1 Yield plant^{-1}

4.3.1.1 Effect of weeding

Yield plant^{-1} was significantly affected by weeding effect at different levels of weeding of blackgram (Table 15). The results showed that the effect of weeding on yield plant^{-1} at harvest, two times of weeding gave the highest yield plant^{-1} (15.92 g plant^{-1}) and no weeding showed the lowest yield plant^{-1} (6.963 g plant^{-1}). One weeding gave the intermediate result (15.92 g plant^{-1}). It can be inferred from the result that 2 wedding showed 128.73% and 38.36% higher yield plant^{-1} than no weeding of single weeding, respectively. The result was in agreement with finding of Rahman *et al.* (1981) who stated that maximum seed yield was obtained when weeds were removed 20 days after sowing.

Table 15. Effect of weeding on yield plant^{-1} at different growth stages of blackgram

Spacing	**Yield plant^{-1} (g)**
No weeding (W_0)	6.96 c
One weeding (W_1)	11.49 b
Two weeding (W_2)	15.92 a
$S_{\bar{x}}$	**0.114**
CV (%)	**10.84**

4.3.1.2 Effect of different spacing

Different spacing of blackgram showed the significant effect on yield plant^{-1} (Table 13). The widest spacing (30×16cm^2) showed the highest yield plant^{-1} and the yield plant^{-1} reduced incrementally with the reduceds of spacing's. The lowest grain weight plant^{-1} (10.71g) was observed in the closest spacing 30×7cm^{2}treatment. On the other hand, the closest two spacing (30×7cm^2 and 30×10cm^2) showed statistically level of yield plant^{-1}. Similar finding was reported by Arya and Kalra (1988) that grain yield plant^{-1} decreased with increasing seed rate application but not suitable for the yield plant^{-1} incase of more plant density.

Table 16. Effect of spacing on yield plant^{-1} at different growth stages of blackgram

Spacing	**Yield plant^{-1} (g)**
30cm × 7cm (D_1)	10.71 c
30cm × 10cm (D_2)	10.86 c
30cm × 13cm (D_3)	11.81 b
30cm × 16cm (D_4)	12.46 a
$S_{\bar{x}}$	**0.131**
CV (%)	**8.44**

4.3.1.3 Interaction effect of different weeding and spacing

The interaction effect of weeding and spacing was found to be significant for yield plant^{-1} (Table 17). The interactions W_2D_4 represent the best result (18.16 g) and the lowest value was obtained from W_0D_1 (4.86 g). The interactions, W_2D_1 and W_2D_2 gave comparatively higher yield and W_0D_2,

W_0D_3, W_1D_1 gave comparatively lower yield but significantly different W_0D_4 and W_0D_4, respectively.

Table 17. Interaction effect of weeding and spacing on yield plant^{-1} at blackgram

Interaction (Weeding × Spacing)	**Yield plant^{-1} (g)**
W_0D_1	5.53 h
W_0D_2	4.86 i
W_0D_3	7.003 g
W_0D_4	10.47 e
W_1D_1	9.757 f
W_1D_2	11.06 e
W_1D_3	12.43 d
W_1D_4	12.72 d
W_2D_1	15.98 b
W_2D_2	15.36 b
W_2D_3	14.18 c
W_2D_4	18.16 a
$S_{\bar{x}}$	**0.227**
CV (%)	**8.44**

W_0 = No weeding
W_1 = One weeding
W_2 = Two weeding

D_1 = 30 cm×7 cm
D_2 = 30 cm ×10 cm
D_3 = 30 cm ×13 cm
D_4 = 30 cm ×16 cm

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

4.3.2.1 Effect of weeding

Grain yield (t ha^{-1}) was significantly affected by at different levels of weeding of blackgram (Table 18). The results showed that two times of weeding gave the highest grain yield (1.39 t ha^{-1}) and no weeding showed the lowest grain yield (0.89 t ha^{-1}). One weeding gave the medium result (1.11 t ha^{-1}). Similar result was found in soybean by Singh *et al.*, 1988. and Mungbean Yadav *et al.*, (1983) where reported that weeded plants showed higher yield compared to un wedded control.

Table18. Effect of weeding on seed yield of blackgram

Weeding	**Grain yield (t ha^{-1})**
No weeding (W_0)	0.89 c
One weeding (W_1)	1.11 b
Two weeding (W_2)	1.39 a
$S_{\bar{x}}$	**0.029**
CV (%)	**10.84**

4.3.2.2 Effect of different spacing

Different spacing of blackgram showed the significant effect on grain yield of black (Table 19). The result showed that optimum spacing (30 cm ×10cm) performed best in producing significantly highest yield than other wider closer spacing , the widest spacing (30 cm ×16cm) gave lowest yield (1.05 t ha^{-1}). It was interesting that both wider and closer spacing than

30×10 cm showed statistically similar grain yield. The result was consistent with the finding of Ganiger et al (2003) where optimum seed rate, and optimum spacing showed higher seed yield of blackgram.

Table 19. Effect of spacing on seed yield of blackgram

Spacing	**seed yield (t ha^{-1})**
30cm × 7cm (D_1)	1.13 b
30cm × 10cm (D_2)	1.22 a
30cm × 13cm (D_3)	1.12 b
30cm × 16cm (D_4)	1.05 b
$S_{\bar{x}}$	**0.033**
CV (%)	**8.44**

4.3.2.3 Interaction effect of different weeding and spacing

The interaction effect was found to be significant for seed yield (Table 20). The interaction W_2D_2 represented the best result (1.58 t ha^{-1}). The interaction W_0D_4 (0.82 t ha^{-1}) gave the lowest result which was not significantly different from W_0D_3, W_0D_2 and W_0D_1.

Table 20. Interaction effect on weeding and spacing on total grain yield of blackgram

Interaction (weeding × spacing)	**seed yield (t ha^{-1})**
W_0D_1	0.95 f-h
W_0D_2	0.91 gh
W_0D_3	0.88 h
W_0D_4	0.82 h
W_1D_1	1.12 d-f
W_1D_2	1.18 c-e
W_1D_3	1.08 e-g
W_1D_4	1.06 e-g
W_2D_1	1.32 bc
W_2D_2	1.58 a
W_2D_3	1.40 b
W_2D_4	1.27 b-d
$S_{\bar{x}}$	**0.058**
CV (%)	**10.84**

W_0 = No weeding
W_1 = One weeding
W_2 = Two weeding

D_1 = 30 cm ×7 cm
D_2 = 30 cm ×10 cm
D_3 = 30 cm ×13 cm
D_4 = 30 cm ×16 cm

4.3.3 Biological yield (t ha^{-1})

4.3.3.1 Effect of weeding

Biological yield (t ha^{-1}) was significantly affected by at different levels of weeding of blackgram (Table 21). The results showed that two times of weeding gave the highest biological yield (3.025 t ha^{-1}) and no weeding showed the lowest biological yield (2.405 t ha^{-1}). One weeding gave the intermediate result (2.65 t ha^{-1}).The result agreed with the findings of Pongkao and Inthong (1988) who reported that optimum weeding on blackgram was found to be superior giving 23 % higher biological yield over the control.

Table 21. Effect of weeding on biological yield and harvest index of blackgram

Weeding	**Biological yield (t ha^{-1})**	**Harvest Index (%)**
No weeding (W_0)	2.405 c	36.44 c
One weeding (W_1)	2.650 b	41.39 b
Two weedings (W_2)	3.025 a	45.59 a
$S_{\bar{x}}$	**0.016**	**0.906**
CV (%)	**7.02**	**6.06**

4.3.3.2 Effect of different spacing

Different spacing of blackgram showed the significant effect on biological yield (Table 22). Treatments D_1 and D_2 gave the best result (2.803 and 2.80 t ha^{-1}respectively) and treatment D_4 gave the lowest result (2.503 t ha^{-1}). D_3 showed the intermediate value of biological yield (2.667 t ha^{-1}) which was significantly different from D_4. Similar results were obtained by Mahboob

and Asghar (2002) who revealed that biological yield and seed yield were greatly influenced by spacing.

Table 22. Effect of spacing on biological yield and harvest index of blackgram

Spacing	Biological yield(t ha^{-1})	Harvest Index (%)
30 cm ×7 cm(D_1)	2.803 a	40.02 b
30 cm ×10 cm (D_2)	2.800 a	42.83 a
30 cm ×13 cm (D_3)	2.667 b	41.62 ab
30 cm ×16 cm (D_4)	2.503 c	40.08 b
$S_{\bar{x}}$	**0.018**	**1.046**
CV (%)	**7.02**	**6.06**

4.3.3.3 Interaction effect of different weeding and spacing

The interaction effect was found to be significant for biological yield (Table 23). The interaction W_2D_2 represented the best result (3.20 t ha^{-1}) and W_0D_4 gave the lowest result (2.22 t ha^{-1}). The treatment, W_2D_3 (3.00 t ha^{-1}) and W_2D_4 (2.80 t ha^{-1}) gave comparatively higher result but significantly different from W_2D_2 and W_0D_4.

Table 23. Interaction effect of weeding and spacing on biological yield and harvest index of blackgram

Interaction (weeding × spacing)	**Biological yield(t ha^{-1})**	**Harvest Index (%)**
W_0D_1	2.55 de	37.25 de
W_0D_2	2.46 ef	36.99 de
W_0D_3	2.39 f	36.82 e
W_0D_4	2.22 g	34.68 e
W_1D_1	2.76 c	40.57 cd
W_1D_2	2.74 c	43.06 bc
W_1D_3	2.61 d	41.37 bc
W_1D_4	2.49 ef	40.56 cd
W_2D_1	3.10 ab	42.25 bc
W_2D_2	3.20 a	48.44 a
W_2D_3	3.00 b	46.66 a
W_2D_4	2.80 c	45.00 ab
$S_{\bar{x}}$	**0.032**	**1.812**
CV (%)	**7.02**	**6.06**

W_0 = No weeding
W_1 = One weeding
W_2 = Two weeding

D_1 = 30 cm×7 cm
D_2 = 30 cm×10 cm
D_3 = 30 cm ×13 cm
D_4 = 30 cm×16 cm

4.3.4 Harvest index

4.3.4.1 Effect of weeding

Harvest index was significantly affected by weeding of blackgram (Table 21). The results showed that two times of weeding gave the highest harvest index (45.59%) and no weeding showed the lowest harvest index (36.44%). One weeding gave the medium result (41.39%).

4.3.4.2 Effect of different spacing

Different spacing of blackgram showed the significant effect on harvest index (Table 22). Treatment D_2 gave the best result (42.83%) which was similar with D_3 and D_1 gave the lowest result (40.02%) which was not significantly different from D_4 (40.08%).Similar result was found by Ganiger *et al.* (2003) that different seed rate (30, 40, 50, 60, 70 kg ha^{-1}) showed different harvest index and optimum seed rate (50 kg ha^{-1}) ensure higher harvest index.

4.3.4.3 Interaction effect of different weeding and spacing

The interaction effect was found to be significant for harvest index (Table 23). The interaction W_2D_2 represented the best result (48.44%) which was not significantly different from W_2D_3 (46.66%) and similar with W_2D_4. The interaction W_0D_4 gave the lowest result (34.68%) which was not significantly different from W_0D_3 (36.82%). The interaction W_1D_1, W_1D_2, W_1D_3, W_1D_4 and W_2D_1 gave comparatively higher result but significantly lower than W_2D_2.

4.4 Weeding effects on yield

4.4.1 Dry weight of weed

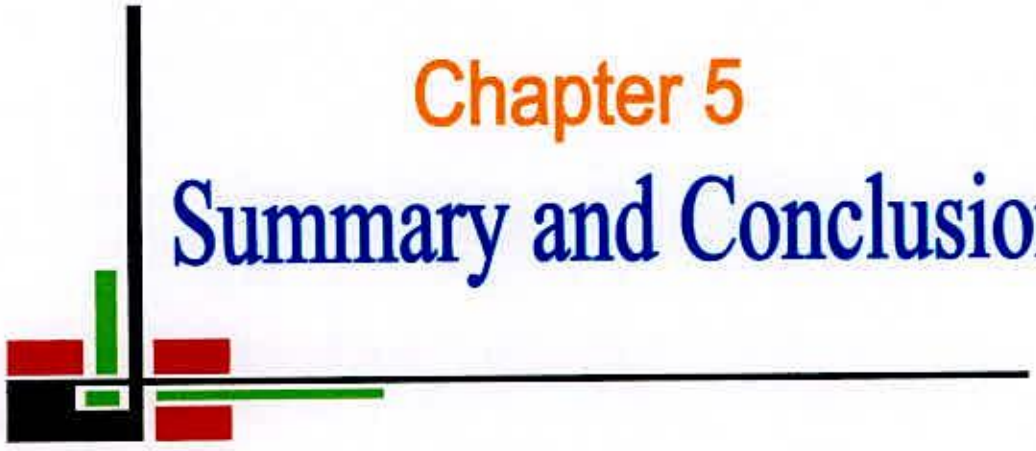
There was no weeding on control treatment. But one weeding was done at 25 DAS in the treatment W_1D_1, W_1D_2, W_1D_3 and W_1D_4. Here, highest weed biomass was obtained from W_1D_4 and lowest from W_1D_1. Again, two weeding was done at 25 and 45 DAS in the treatment W_2D_1, W_2D_2, W_2D_3 and W_2D_4. The total weed biomass counted to study the rate of crop weed competition for nutrients. It was observed that maximum weed biomass was removed from W_2 D_2 and minimum from W_2 D_1 (Table 30). So it could be said that W_2D_2 was minimized more effectively from weed infestation at later stage.

Table 24. Dry biomass of weed population (g) of each treatment according to the interaction of weeding and spacing of blackgram

No weeding			
Treatments	**Control**		
T_1 (W_0 D_1)	0		
T_2 (W_0 D_2)	0		
T_3 (W_0 D_3)	0		
T_4 (W_0 D_4)	**0**		
$S_{\bar{x}}$	--		
CV (%)	--		
One weeding			
Treatments	**25 DAS**		
	(g m^{-2})		
T_5 (W_1 D_1)	3.91 b		
T_6 (W_1 D_2)	4.49 ab		
T_7 (W_1 D_3)	4.53 ab		
T_8 (W_1 D_4)	4.77 a		
$S_{\bar{x}}$	**0.912**		
CV (%)	**8.56**		
Two weeding			
Treatments	**25 DAS**	**40 DAS**	**Total**
	(g m^{-2})	**(g m^{-2})**	**(g m^{-2})**
T_9 (W_2 D_1)	5.06 ab	18.37 b	23.43 b
T_{10} (W_2 D_2)	5.14 ab	21.69 a	26.83 a
T_{11} (W_2 D_3)	4.70 b	13.10 c	17.80 c
T_{12} (W_2 D_4)	5.87 a	18.07 b	23.94 b
$S_{\bar{x}}$	**0.827**	**0.698**	**0.712**
CV (%)	**7.28**	**8.31**	**9.42**

W_0 = No weeding
W_1 = One weeding
W_2 = Two weeding

D_1 = 30 cm×7 cm
D_2 = 30 cm×10 cm
D_3 = 30 cm ×13 cm
D_4 = 30 cm ×16 cm



Chapter 5

Summary and Conclusion

Chapter 5

SUMMARY AND CONCLUSION

The experiment was conducted at the research field of Sher-e-Bangla Agricultural University (SAU) during the period from March, 2007 to June, 2007 to study the influence of weeding and spacing on the performance of blackgram. Twelve treatments were included in the study. The experiment was conducted in randomized complete block design (RCBD)(facterial) with three replications. The results are summarized below.

Significant variation was found in plant height for weeding levels. Two weeding gave the tallest plant. Spacing of 30cm×16 cm produced the tallest plant and the Spacing of 30cm×7 cm gave the shortest plant among the treatments. Maximum plant height was found from the interaction of two weeding and of 30cm×16 cm spacing at 60 DAS.

Dry weight was greatly influenced by weeding. The control (no weeding) treatment produced the lowest dry weight plant^{-1} for all growth stages. Two weeding produced the highest dry weight at all growth stages. Among spacing of 30cm×16 cm produced the highest dry weight. The interaction of two weeding with 30cm×16 cm s and 30cm×13 cm spacing showed the maximum dry weight and the lowest was observed in the interaction of no weeding with 30cm×7 cm spacing at the time of harvest.

Two weeding produced the highest number of branches plant^{-1} and that was minimum in the control.. The highest and the lowest number of branches plant^{-1} were observed in 30cm×16 cm spacing and 30cm×7 cm spacing, respectively. On the other hand interaction of two weeding with

30cm×16 cm spacing produced the highest number of branches plant^{-1} (7.64).

Number of pods plant^{-1} was highest (14.40) with two weeding and that of lowest with zero weeding (7.12). The spacing, 30cm×16 cm produced the highest (12.91) and 30cm×7 cm spacing produced the lowest (9.16) pod plant^{-1}. Interaction two weeding with 30cm×16 cm spacing produced the highest number of pod plant^{-1} (18.88) and no weeding with the 30cm×7 cm spacing interaction produced the lowest number of pod plant^{-1} (5.39).

Number of seeds pod^{-1} was significantly affected by weeding, plant spacing and their interaction. Two weeding produced the highest number of seeds pod^{-1} (7.47) where as no weeding produced lowest. But there is no significant effect of spacing on seeds pod^{-1}. Treatment combination of two weeding with 30cm×16 cm spacing and one weeding with 30cm×16 cm spacing produced highest number of seeds pod^{-1} (7.99 and 7.97) and one weeding with 30cm×7 cm spacing gave similar result (7.45). No weeding with 30cm×7 cm spacing showed lowest seeds pod^{-1} (5.80).

Thousand seed weight was significantly influenced with weeding but not with spacing. Two weedings produced highest weight of 1000 seeds, whereas no weeding produced the lowest 1000 seed weight. Interaction of two weedings with 30cm×10 cm spacing produced the highest weight of 1000 seeds (42.40 g) and no weeding with 30cm ×7 cm spacing produced the lowest 1000 seed weight (41.36 g).

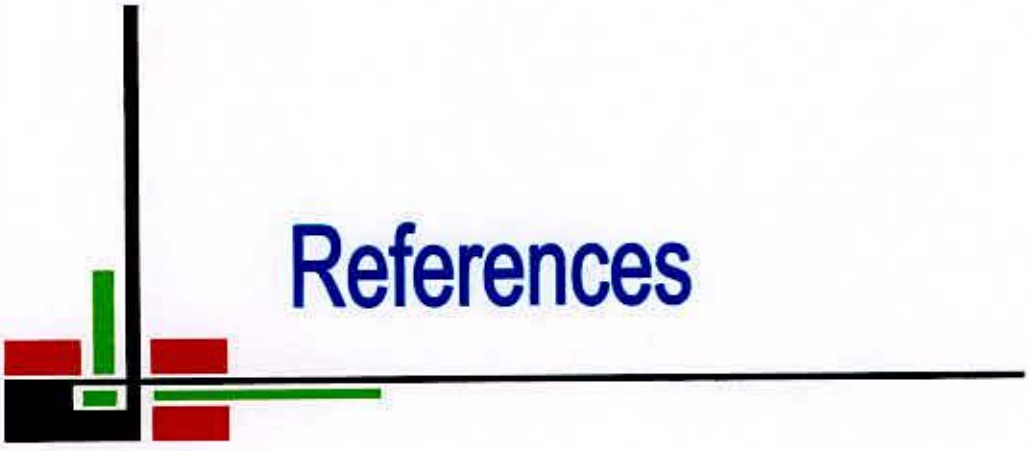
Seed yield (kg ha^{-1}) varied significantly among the weeding levels,plant spacing variation and there interaction. Two weedings produced the highest seed yield whereas control treatment produced the lowest yield

ha^{-1}. 30cm×10 cm spacing and 30cm×16 cm spacing produced the highest and lowest seed yield respectively. Interaction of two weeding with the spacing of 30cm×10 cm spacing produced the highest seed yield (1.58 t ha^{-1}) which was 92.68% higher than that of the lowest yield (0.82 t ha^{-1}) by no weeding with 30cm×16 cm spacing.

Weeding levels, plant spacing and their interaction showed significant variation on biological yield. Two weedings produced the highest (3.025 t ha^{-1}) and control produced the lowest (2.405 t ha^{-1}) biological yield. The spacing, 30cm×10 cm produced the highest biological yield (2.8 t ha^{-1}). The interaction effect showed that two times of weeding with the spacing of 30cm×10 cm produced highest biological yield (2.60 t ha^{-1}) and no weeding with the spacing of 30cm×7 cm showed the lowest (1.27 t ha^{-1}) biological yield.

Among the three levels of weeding, two weeding gave the highest harvest index (45.59%) and 30cm×10 cm spacing produced the highest harvest index (42.83%). Interaction of two weedings with 30cm×10 cm spacing produced the highest harvest index (48.44%) in this study.

From the present study, it must be concluded that weeding levels influence the growth, yield and yield components of blackgram. Any weeding weeding levels and spacing two weeding (at 25 and 40 DAS), the spacing, 30cm×10 cm and the interaction between two weeding with 30cm×10 cm spacing was found to be most promising.



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Appendices

APPENDICES

Appendix I. Physical characteristics and chemical composition of soil of the experimental plot

Soil Characteristics	Analytical results
Agrological Zone	Madhupur Tract
P^H	5.46 – 5.61
Organic matter	0.80
Total N (%)	0.41
Available phosphorous	21 ppm
Exchangeable K	0.42 meq / 100 g soil

Source: Soil Resources Development Institute (SRDI, 2006)

Appendix II. Monthly record of air temperature, rainfall, relative humidity, soil temperature and Sunshine of the experimental site during the period from March to June 2007

Year	Month	*Air temperature (°c)		*Relative humidity (%)	Rain fall (mm) (total)	*Sunshine (hr)
		Maximum	Minimum			
2007	March	31.4	19.6	54	11	8.2
	April	33.6	23.6	69	163	6.4
	May	34.7	25.9	70	185	7.8
	June	36.08	23.29	73	195	6.78

* Monthly average,

* Source: Bangladesh Meteorological Department (Climate and weather division) Agargoan, Dhaka - 1212