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Effect of weeding on the growth, yield and yield contributing characters of mungbean (*Vigna radiata* L.)

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Abstract

An experiment was conducted at the Agronomy Field Laboratory of Bangladesh Agricultural University, Mymensingh to assess the effect of weeding on growth, yield and yield contributing characters of mungbean *(Vigna radiata* L.) *cv.* BINA mung- 4 during October 2011 to February 2012. The experiment was laid out in a randomized complete block design with four replications. The trial comprised seven treatments namely, T_1 = no weeding, T_2 = one-stage weeding (Emergence-Flowering), T_3 = one-stage weeding (Flowering-Pod setting), T_4 = one-stage weeding (Pod setting-Maturity), T_5 = two-stage weeding (Emergence-Flowering and Flowering-Pod setting), T_6 = two-stage weeding (Flowering-Pod setting and Pod setting-Maturity) and T_7 = three-stage weeding (Emergence-Flowering and Flowering-Pod setting and Pod setting-Maturity). The growth parameters such as relative growth rate (0.075 g g^{-1} day^{-1}) and net assimilation rate (0.075 g $m^{-2}day^{-1}$) showed the best performance with T_2 at one-stage weeding condition (Emergence-Flowering). Three-stage weeding ensured the highest plant height (58.62 cm) as well as the highest number of branches (4.45) and leaves (10.34) $plant^{-1}$. Dry weight $plant^{-1}$ (12.38g) was highest from three stage weeding and the lowest from no weeding treatment. The highest number of pods (22.03) $plant^{-1}$, the longest pod (5.95 cm), the highest number of seeds (17.07) pod^{-1} and the highest seed yield (1.38 t ha^{-1}) were obtained from three-stage weeding (Emergence-Flowering and Flowering-Pod setting and Pod setting-Maturity) in mungbean. On the other hand, the lowest seed yield was obtained under no weeding condition. The highest seed yield resulted in higher biological yield (4.70 t ha^{-1}) and the highest harvest index (37.15%) in three-stage weeding and the lowest from no weeding. Number of pods $plant^{-1}$, length of pod, number of seeds pod^{-1} and 1000-seed weight showed highly significant positive correlations with seed yield. These parameters strongly influenced the growth, yield and yield contributing characters of mungbean *(Vigna radiata* L.).

Keywords: Weeding, Mungbean, Growth, Yield, Correlation

Introduction

Mungbean (*Vigna radiata* L.) is an important pulse crop in Bangladesh. In Bangladesh, mungbean ranks third in acreage and production but ranks first in market price. It has good digestibility and flavor. Mungbean contains 51% carbohydrate, 26% protein, 10% moisture, 4% mineral and 3% vitamin (Afzal *et al*., 2008). Mungbean is highly adapted to the agro-climatic conditions of Bangladesh. Though the agro-ecological conditions of Bangladesh are favorable for mungbean cultivation, its area under cultivation and total production are low in this country (BBS, 2008). In Bangladesh, the average yield of mungbean is 0.69 t ha^{-1} (BBS, 2011), which is much lower than those of India and other countries of the world.

There are many reasons of lower yield of mungbean. Weed is one of the most important factors responsible for low yield of mungbean. The decrease in mungbean productivity due to weed competition is 45.6% (Pandey and Mishra, 2003). Mungbean is very competitive against weed and therefore, weed control is essential for mungbean production. Dry weight of weed increased as the duration of weed competition increased in crop (Islam *et al.,* 1989).

Weeds compete with main crop for space, nutrients, water and light. It is also recognized that a low weed population can be beneficial to the crop as it provides food and habitat for a range of beneficial organisms (Bueren *et al.*, 2002). Weed crop competition commences with germination of the crop and continues till its maturity. Several Growth stages of mungbean such as emergence, flowering and pod setting are greatly hampered by weed. Weed infestation of these stages causes low pod setting and ultimately yield reduces. Weeds above critical population thresholds can significantly reduce crop yield and quality. Weed problem is becoming more and more acute. Weeds have been reported to harbor the viruses and act as a primary source of inoculums, which causes high incidence of virus-like symptoms. However, the aim of weed management should be to maintain weed population at a manageable level. Timely control of weeds is essential for high yield in mungbean. Significantly more seed yields by weeding have been reported in mungbean (Hossain *et al*., 1990; Kumar and Kiron, 1990; Musa *et al*., 1996).

Thus, proper weed management is the main concern for maximum yield of mungbean. Though mungbean is cultivated in many parts of our country, very little research work has been done regarding the effect of weeding on growth and yield contributing characters of mungbean. In the light of above background, the present study was designed to investigate the effects of weeding on growth, yield and yield components of mungbean.

Materials and Methods

The experiment was conducted at the Agronomy Field Laboratory of Bangladesh Agricultural University, Mymensingh during October 2011 to February 2012. The topography of the field was medium high, silt loam in texture and more or less neutral in reaction and moderate drained condition. The selected variety of mungbean in this experiment is BINA mung- 4. There were seven treatments in this experiment (Fig. 1) : T_1 = no weeding, T_2 = one-stage weeding (Emergence-Flowering), T_3 = one-stage weeding (Flowering-Pod setting), T_4 = one-stage weeding (Pod setting-Maturity), T_5 = two-stage weeding (Emergence-Flowering and Flowering-Pod setting), T_6 = two-stage weeding (Flowering-Pod setting and Pod setting-Maturity) and T_7 = three-stage weeding (Emergence-Flowering, Flowering-Pod setting and Pod setting-Maturity). The experiment was laid out in a randomized complete block design with four replications. The whole experimental area was divided into four blocks. Each block was divided into seven unit plots of 4.0 m × 2.5 m size each. Thus, the total number of unit plots was 28 (7×4). Seeds of mungbean variety viz. BINA mung-4 were collected from the Bangladesh Institute of Nuclear Agriculture (BINA), Bangladesh Agricultural University, Mymensingh. The experimental field was first opened with a power tiller on 15 October 2011. The experimental field was prepared by four times ploughing and cross ploughing followed by laddering. The weeds and stubble were removed from each plot and the field was leveled properly before sowing.

	Treatments	Emergence	Flowering	Pod setting	Maturity
1	T_1 (No weeding)				
2	T_2 (E-F)	■	■		
3	T_3 (F-P)		■	■	
4	T_4 (P-M)			■	■
5	T_5 (E-F-P)	■	■	■	
6	T_6 (F-P-M)		■	■	■
7	T_7 (E-F-P-M)	■	■	■	■

E=Emergence, F=Flowering, P=Pod setting, M=Maturity

Fig. 1 Scheme showing developmental phases during which weeding was applied

Each unit plot was uniformly fertilized with urea, triple superphosphate, muriate of potash, gypsum, zinc sulphate and molibdenum at the rate of 40, 100, 50, 70, 4 and 2 kg ha^{-1} respectively, as recommended by the Bangladesh Institute of Nuclear Agriculture (BINA, 2011). All fertilizers were applied at the time of final land preparation. Seeds were sown on 20 October 2011 in rows at 2-3 cm depth and row to row distance was 30 cm. Crop management practices such as drainage, plant protection measures were done as per requirement and weeding was done as per treatment. Data on growth attributes and morphological parameters were collected at 40, 50, 60 DAS and at harvest. At physiological maturity ten plants $plot^{-1}$

were selected randomly, sundried and growth parameters viz. plant height, number of branches plant^{-1}, number of leaves plant^{-1}, crop growth rate (CGR), relative growth rate (RGR), net assimilation rate (NAR); yield and yield contributing characters viz. number of pods plant^{-1}, pod length (cm), weight of seeds pod^{-1} (g), 1000-seed weight (g), seed yield (g plant^{-1}), seed yield (t ha^{-1}), stover yield (g plant^{-1}), stover yield (t ha^{-1}), biological yield (t ha^{-1}), harvest Index (HI) were recorded.

Crop growth rate is the increase in the plant dry matter production per unit of time per unit of ground area (Hunt, 1978). It was calculated by using the following formula:

$$CGR = \frac{w_2 - w_1}{T_2 - T_1} g m^{-2} d^{-1}$$

Where, W_1 = Total dry weight at time (T_1) and W_2 = Total dry weight at time (T_2)

Relative growth rate is the rate of DM production per unit of time. It was calculated by using the following formula:

$$RGR = \frac{\ln w_2 - \ln w_1}{T_2 - T_1} g\ g^{-1} day^{-1}$$

Where, W_2 and W_1 are the DM at the time T_2 and T_1, respectively and $\ln$ is the natural logarithm.
Net assimilation rate is the rate of DM production per unit of leaf area per unit of time. It was calculated by using the following formula:

$$NAR = \frac{w_2 - w_1}{T_2 - T_1} \times \frac{\ln LA_2 - \ln LA_1}{LA_2} g\ m^{-2}\ day^{-1}$$

Where, W_2 and W_1 are the DM at the timeT_2 and T_1, respectively. LA_2 and LA_1 are leaf area at the time T_2 and T_1, respectively. NAR ranges between -1 to +5.5g m^{-2} day^{-1}.

Collected data were analyzed statistically using MSTAT-C programme and the means were compared by Duncan's Multiple Range Test (DMRT) at 5% level of probability (Gomez and Gomez, 1984). Correlation coefficient (r) was calculated among different variables and correlation matrix was also prepared to find out the relationship among variable to weeding. Regression co-efficient or percent variation accounted (R^2) was also measured.

Results and Discussion

Growth parameters

Plant height was significantly affected by weeding at the all sampling days (40 DAS, 50 DAS, 60 DAS and at harvest) (Table 1). At 40 DAS the tallest plant height (25.31cm) was obtained from T_7 where crops received three times weeding from Emergence to Maturity and shortest plant height (18.36 cm) was obtained from T_4 where crop received one time weeding from Pod setting to Maturity. At 50 DAS tallest plant height (30.52 cm) was obtained from T_7 where crop received three times weeding from Emergence to Maturity and shortest plant height (19.54 cm) was obtained from no weeding treatment. At 60 DAS tallest plant height (40.90 cm) was obtained from T_3 where crop received one time weeding from flowering to pod setting and shortest plant height (31.94 cm) was obtained from no weeding treatment. At harvest tallest plant height (59.17 cm) was obtained from T_3 and shortest plant height (36.68 cm) was obtained from no weeding treatment. These results indicate that plant height increased with the increase in the number of stage of weeding. Decreased plant height in no weeding condition might be due to inhibition of cell division or cell enlargement.

Number of branches plant^{-1} significantly differed at 40 DAS, 50 DAS, 60 DAS and at harvest (Table 1). At 40 DAS, the highest number of branches plant^{-1} (1.10) was observed from T_7 where crop received three times weeding from Emergence to Maturity and the lowest number of branches plant^{-1} (0.83) was recorded with no weeding treatment. Similarly, at 50 DAS, 60 DAS and at harvest, the highest number of branches plant^{-1} (1.41), (2.85) and (4.45) was observed from three times weeding from Emergence to Maturity (T_7) and the lowest number of branches plant^{-1} was observed from no weeding treatment. The results revealed that weeding had direct effect to increase the number of branches. With decreasing weed population, number of branches plant^{-1} increased in mungbean, because of higher absorption of nutrient and water from soil. As a result, activity of cell increased. This favoured more vegetative growth and produced higher number of branches in mungbean plant.

Table 1. Effect of weeding on plant height (cm) and no. of branches plant^{-1} of mungbean

Treatment	Plant height (cm)				Branches plant^{-1} (no.)			
	40 DAS	50 DAS	60 DAS	At harvest	40 DAS	50 DAS	60 DAS	At harvest
T_1	22.30bc	19.54c	31.94c	36.68d	0.83c	1.14d	1.41e	2.01d
T_2	21.17c	24.73b	39.24a	53.46b	1.05b	1.23c	2.31d	3.88c
T_3	22.83b	24.24b	40.90a	59.17a	1.03ab	1.28bc	2.54b	4.21b
T_4	18.36d	20.72c	34.15bc	36.76d	1.06b	1.37ab	2.37cd	4.26ab
T_5	18.93d	24.43b	32.27c	47.08c	1.02b	1.34ab	2.51bc	4.15b
T_6	17.98d	21.05c	35.60b	37.75d	1.03ab	1.33ab	2.60b	4.14b
T_7	25.31a	30.52a	40.79a	58.62a	1.10a	1.41a	2.85a	4.45a
CV (%)	4.60	5.28	4.51	4.05	9.26	4.49	4.41	10.36
Level of sig.	**	**	**	**	*	**	**	**

In a column, figures with similar letter (s) or without letter do not differ significantly (as per DMRT) at 5% level of probability, *= Significant at 5% level of probability, **= Significant at 1% level of probability.

Number of leaves plant^{-1} varied significantly by weeding at 40 DAS, 50 DAS, 60 DAS and at harvest (Table 2). Maximum number of leaves plant^{-1} at 40 DAS, 50 DAS, 60 DAS and at harvest were obtained from three times weeding from Emergence to Maturity (T_7) and minimum number of leaves plant^{-1} was obtained from no weeding treatment at 40 DAS, 50 DAS, 60 DAS and at harvest. So, weeding had a direct and positive effect on the number of leaves plant^{-1}. Due to increase in weeding level, plant received more light and activity of vascular tissue increased. Ultimately number of leaves plant^{-1} increased.

The influence of weeding on dry weight plant^{-1} was found significant at 40 DAS, 50 DAS, 60 DAS and at harvest (Table 2). The highest dry weight plant^{-1} (0.79g), (8.14g), (12.38g), (17.95g) were obtained from T_7 at three times weeding (E-M) condition and the lowest amount of dry weights plant^{-1} (0.24g), (4.13g), (6.36g) and (8.50g) were obtained from the no weeding treatment at all sampling days. It was observed that increase in level of weeding increased plant dry weight and the decreased level of weeding reduced the plant dry weight. This indicates that weeding had a direct effect on dry weight of plant. Accumulation of lower dry weights for control treatment might be due to lack of internal nutrient of plant, which caused reduction in both cell division and cell elongation and reduced carbohydrate synthesis and hence the growth was reduced.

Crop growth rate (CGR) varied significantly under different weeding condition (Table 3). At 40-50 DAS, the highest crop growth rate (0.74) was found at T_7 where crop received three-stage weeding from emergence to maturity. The lowest CGR (0.39) was recorded from no weeding condition (T_l) and the CGR from T_2 and T_5 were found similar result. At 50-60 DAS the highest CGR (0.58) was recorded from T_2 and the lowest (0.22) from T_1. 60 DAS to at maturity the highest CGR (0.61) was recorded from T_6 and the minimum (0.21) was found from T_1.

Table 2. Effect of weeding on number of leaves plant^{-1} and dry weight plant^{-1} of mungbean

Treatment	Leaves plant^{-1} (no.)				Dry wt. plant^{-1} (g)			
	40 DAS	50 DAS	60 DAS	At harvest	40 DAS	50 DAS	60 DAS	At harvest
T_1	3.01c	3.75c	5.25c	8.00c	0.24d	4.13f	6.36f	8.50d
T_2	4.25ab	7.15b	9.46b	11.82b	0.34d	5.98d	12.21ab	17.39a
T_3	3.70b	7.15b	9.30b	11.42b	0.50c	6.51c	11.81bc	16.37b
T_4	3.65b	7.05b	9.40b	11.21b	0.49c	5.53e	11.00e	15.17c
T_5	3.68b	7.00b	9.24b	11.85b	0.62bc	6.20cd	11.48cd	16.67b
T_6	3.73b	7.10b	9.06b	12.14ab	0.72ab	7.34b	11.30de	16.36b
T_7	4.60a	8.28a	10.34a	13.96a	0.79a	8.14a	12.38a	17.95a
CV (%)	8.37	4.09	5.80	2.51	2.43	2.76	4.25	7.86
Level of sig.	**	**	**	**	**	**	**	**

In a column, figures with similar letter (s) or without letter do not differ significantly (as per DMRT) at 5% level of probability, **= Significant at 1% level of probability.

Table 3. Effect of weeding on crop growth rate (CGR), relative growth rate (RGR) and net assimilation rate (NAR) of mungbean

Treatment	CGR			RGR			NAR		
	40-50 DAS	50-60 DAS	60 DAS to Maturity	40-50 DAS	50-60 DAS	60 DAS to Maturity	40-50 DAS	50-60 DAS	60 DAS to Maturity
T1	0.39e	0.22c	0.21e	0.047c	0.004c	0.003c	0.047c	0.004c	0.003c
T2	0.56c	0.58a	0.45cd	0.075a	0.018a	0.007b	0.075a	0.018a	0.007b
T3	0.60c	0.57a	0.42d	0.057bc	0.013b	0.004c	0.057bc	0.013b	0.004c
T4	0.50d	0.55a	0.42d	0.058b	0.018a	0.006b	0.058b	0.018a	0.006b
T5	0.56c	0.53a	0.52bc	0.072a	0.018a	0.011a	0.072a	0.018a	0.011a
T6	0.66b	0.40b	0.61a	0.054bc	0.006c	0.009a	0.054bc	0.006c	0.009a
T7	0.74a	0.42b	0.56ab	0.054bc	0.006c	0.007b	0.054bc	0.006c	0.007b
CV (%)	11.95	7.08	7.71	24.96	2.37	2.75	24.96	2.37	2.75
Level of significance	**	**	**	**	**	**	**	**	**

In a column, figures with similar letter (s) or without letter do not differ significantly (as per DMRT) at 5% level of probability
**= Significant at 1% level of probability

Relative growth rate (RGR) varied significantly under different weeding condition (Table 3). At 40-50 DAS, the highest relative growth rate (0.075) was found from T_2. The lowest RGR (0.047) was recorded from T_5. T_6, T_7 showed similar result. At 60 DAS to Maturity, the highest RGR (0.011) was recorded from T_5 and the minimum (0.003) was found from T_1. These results showed that RGR decreased with increasing crop age.

Net assimilation rate (NAR) influenced significantly by weeding (Table 3). At 40-50 DAS, the highest NAR (0.075) was recorded from T_2 and the lowest (0.047) NAR from T_1. Similar results were found from T_6 and T_7. At 50- 60 DAS, the highest NAR (0.018) was obtained from T_5, which were statistically identical at T_2 and T_4. The lowest (0.004) from T_1 at no weeding treatment. At 60 DAS to Maturity the highest NAR (0.011) was found from T_5 and the lowest (0.003) from T_1. T_2 and T_7 showed similar results. The results indicated that NAR decreased with increasing crop age and NAR was the highest as the number of stages of weeding increased. The decreasing trend of NAR might be due to reduced photosynthetic activity during the later stages because of senescence of leaves. Weed infestation at vegetative growth stage significantly decreased NAR and concluded that to obtain maximum NAR, weeding should be extended across all growth stages, especially during the reproductive stage.

Yield and yield components

Results revealed that all yield and yield contributing characters were significantly influenced by weeding (Table 4). The highest number of pods plant^{-1} (22.03), mature pods plant^{-1} (15.22), pod length (5.95cm), number of seeds pod^{-1} (17.07), seed weight plant^{-1} (23.51g), 1000- seed weight (39.71g), seed yield (1.38t ha^{-1}) and stover yield (3.41 t ha^{-1}) were found in T_7 (three stages weeding from Emergence to Maturity) and the lowest number of pods plant^{-1} (12.15), mature pod plant^{-1}(9.21), pod length (4.12 cm), number of seeds pod^{-1} (9.99), seed weight plant^{-1} (7.85g), 1000- seed weight (27.87g), seed yield (0.91t ha^{-1}) and stover yield (1.76 t ha^{-1}) were found in T_1 (no weeding treatment). The highest seed yield from T_7 occurred due to increased number of pods plant^{-1}, larger-number of seeds plant^{-1} and the highest weight of individual seed. T_7 produced the highest yield might be due to maximum production of crop characters and influenced the plant to have good production of dry matter in early stage and that eventually raised and partitioned to the reproductive units. The weeding also helped optimum seed development. Lower assimilate production for inhibition of photosynthesis and less translocation toward the reproductive organ happened due to unweeded condition in T_1 and resulted in lower seed yield. This result was supported by Raman and Krishnamoorthy (2005). The biological yield and harvest index were found to vary under different weeding conditions. The highest biological yield (4.70 t ha^{-1}) was obtained in plants from T_6 (two stage weeding) and the lowest biological yield (2.67 t ha^{-1}) was recorded from T_1. The highest harvest index (37.15%) was obtained from T_4 (one-stage weeding treatment, P-M) and the lowest harvest index (30.85%) was recorded from T_7 (Table 4).

Table 4. Effect of weeding on yield and yield components of mungbean

Treatment	Pods plant^{-1} (no.)	Mature pods plant^{-1} (no.)	Length of pod (cm)	Seeds pod^{-1} (no.)	Seed wt. plant^{-1} (g)	1000-seed wt. (g)	Seed yield (t ha^{-1})	Stover yield (t ha^{-1})	Biological Yield (t ha^{-1})	Harvest Index (%)
T_1	12.15e	9.21f	4.12e	9.99d	7.85f	27.87d	0.91e	1.76d	2.67e	34.12b
T_2	19.60b	13.89b	5.41c	14.49c	11.53e	33.10c	1.15d	2.30c	3.44cd	33.30bc
T_3	17.16d	10.93de	5.68b	14.20c	14.64c	38.10ab	1.18c	2.40c	3.59c	33.02bc
T_4	18.35c	11.32d	5.19d	14.55c	13.37cd	34.09c	1.19c	2.01c	3.19d	37.15a
T_5	18.02c	11.86c	5.26cd	16.05b	18.74b	37.70b	1.20c	2.56	3.76c	32.25bc
T_6	17.26d	10.53e	5.20d	16.60ab	16.91b	38.24ab	1.29b	3.41ab	4.70a	27.51d
T_7	22.03a	15.22a	5.95a	17.07a	23.51a	39.71a	1.38a	3.09a	4.47b	30.85c
CV (%)	2.19	3.22	4.64	2.42	7.24	3.37	1.57	5.95	4.06	4.38
Level of sig.	**	**	**	**	**	**	**	**	**	**

In a column, figures with similar letter (s) or without letter do not differ significantly (as per DMRT) at 5% level of probability
**= Significant at 1% level of probability.
Where, T_1 = no weeding, T_2 = one-stage weeding (Emergence-Flowering), T_3 = one-stage weeding (Flowering-Pod setting), T_4 = one-stage weeding (Pod setting-Maturity), T_5 = two-stage weeding (Emergence Flowering and Flowering-Pod setting), T_6 = two-stage weeding (Flowering-Pod setting and Pod setting-Maturity) and T_7 = three-stage weeding (Emergence-Flowering and Flowering-Pod setting and Pod setting-Maturity).

Correlation and Regression

Correlation between yield per plant and other characters: The correlation coefficients between yield and chosen components traits are presented in (Table 5). Number of pods plant^{-1}, number of seed pod^{-1} showed highly significant correlations (0.979 and 0.937, respectively) with seed yield plant^{-1}. The correlation among pod length and yield plant^{-1} was significantly positive (0.845). The correlation among seed weight plant^{-1} and yield plant^{-1} was significantly positive (0.877) and the correlation among 1000-seed weight and yield plant^{-1} was significantly positive (0.899). All other correlation with yield were also positive and but not strongly correlated with yield. All had positive and significant association with final grain yield of mungbean.

Table 5. Correlations matrix between yield and yield components

Parameters	Pods plant^{-1} (no.)	Pod length (cm)	Seeds pod^{-1} (no.)	Seed wt. plant^{-1} (g)	1000-seed wt. (g)	Yield plant^{-1}
Pods plant^{-1} (no.)	1.000					
Pod length (cm)	0.825(**)	1.000				
Seeds pod^{-1} (no.)	0.930(**)	0.781(**)	1.000			
Seed wt. plant^{-1} (g)	0.855(**)	0.706(**)	0.867(**)	1.000		
1000-seed wt. (g)	0.839(**)	0.790(**)	0.888(**)	0.890(**)	1.000	
Yield plant^{-1}	0.979(**)	0.845(**)	0.937(**)	0.877(**)	0.899(**)	1.000

** Correlation is significant at the 0.01 level (2-tailed), * Correlation is significant at the 0.05 level (2- tailed)

The relation among number of pod plant^{-1}, pod length, number of seed pod^{-1}, 1000- seed weight and yield were positive and linear (R^2 = 0.958, R^2 = 0.714, R^2 = 0.877 and R^2 = 0.807, respectively) (Fig. 2, Fig. 3, Fig. 4 and Fig. 5, respectively).

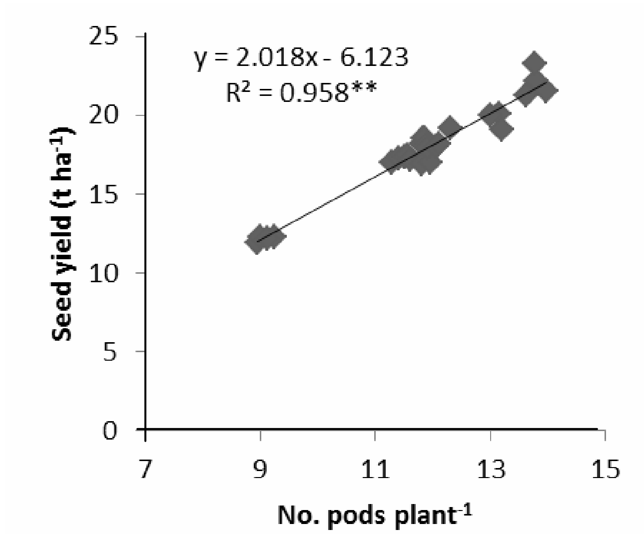

Fig. 2. Regression of no. of pods plant^{-1} on seed yield of mungbean

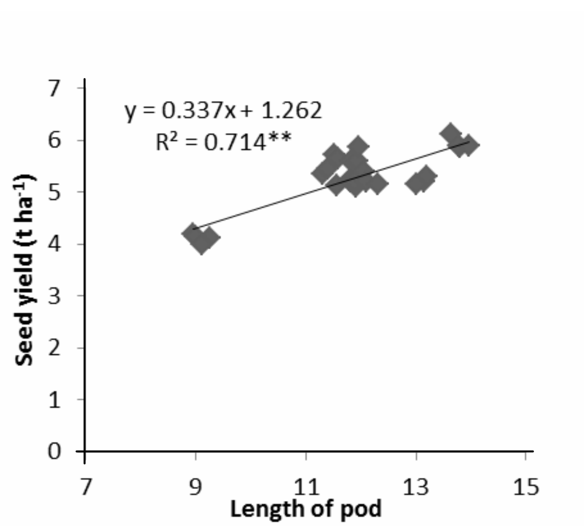

Fig. 3. Regression of length of pod on seed yield of mungbean

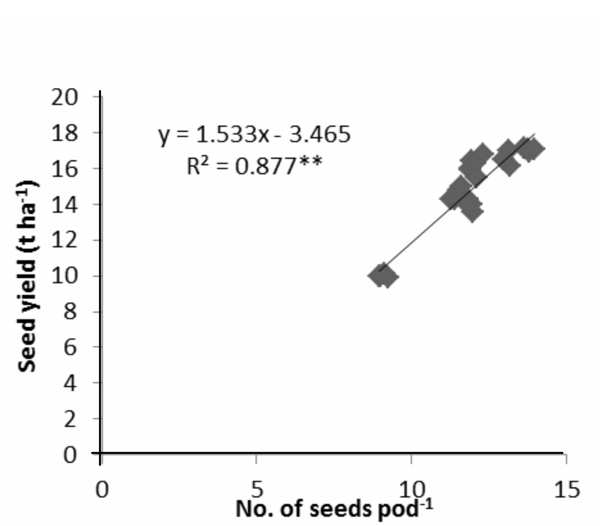

Fig. 4. Regression of no. of seed pod^{-1} on seed yield of mungbean

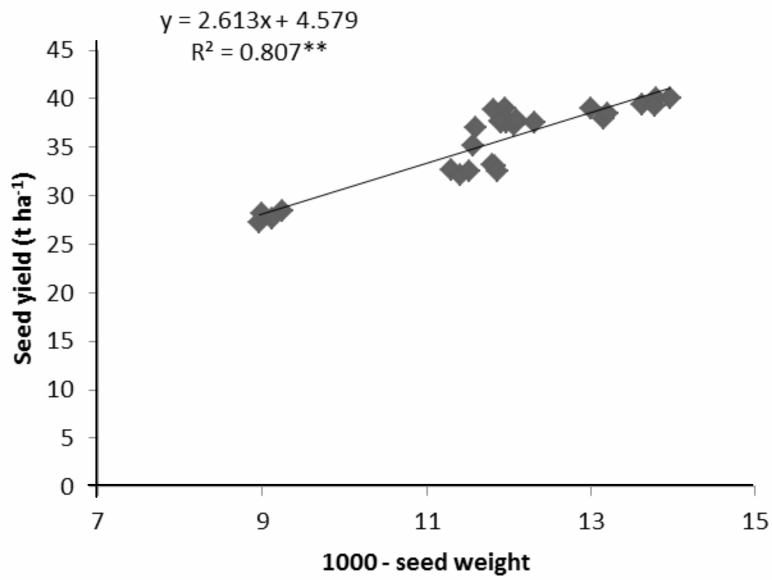

Fig. 5. Regression of 1000-seed weight on seed yield of mungbean

Conclusion

From the above results, it may be concluded that BINA mung- 4 gave maximum yield at three-stage weeding in the three different growth stages like emergence to flowering (E-M), flowering to pod setting (F-P) and pod setting to maturity (P-M).

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