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EFFECT OF CROP DENSITY AND TIME OF WEEDING ON THE PERFORMANCE OF MUNGBEAN*

M. A. Maleque Talukder, A. Hashem and A. Hamid

Department of Agronomy
Institute of Postgraduate Studies in Agriculture
Gazipur 1703, Bangladesh

Abstract

The effect of crop density (33 and 50 palnts/m^2) and time of weeding (at 0, 7, 14, 21, 28, 35, and 42 days after emergence and no-weeding) were evaluated for mungbean during September to December, 1992 at IPSA Farm. Among the 17 weed species identified at harvest, *Cynodon dactylon* was the most dominant (33%) in weeded plots and *Cyperus rotundus* was the most dominant (21.05%) in the unweeded plots. Weed population and dry biomass of weed at a density of 50 plants/m^2 were 20% and 13% less respectively than those of 33 plants/m^2. However, high density produced lower yield than the optimum density. Highest yield (1762 kg/ha) of mungbean was obtained in plots of 33 plants/m^2 weeded at emergence and the lowest yield (1137 kg/ha) in plots of 50 plants/m^2 that remained unweeded. Delay in weeding decreased seed yield and yield attributes of mungbean but increased dry biomass of weed. The critical period of weed control appeared to be between 7 and 14 DAE. Unrestricted growth of weed reduced mungbean seed yield by 30 to 33%. Linear regression model predicted that for one kg/ha of weed growth, mungbean seed yield is reduced by 0.395 kg/ha.

Key words : Mungbean density, Time of weeding, Weed biomass, Yield Prediction.

Introduction

Mungbean (*Vigna radiata* L. Wilczek) is one of the most important pulse crops in Bangladesh. It has high protein content. Being a short duration crop it fits well into the intensive cropping system. Average yield of mungbean is 514 kg/ha in Bangladesh (BBS,1991). Weed is one of the most important factors responsible for low yield of crops (Islam *et al.*, 1989). Mungbean is not very competitive against weed and, therefore, weed control is essential for mungbean production (Moody, 1978). Yield losses due to uncontrolled weed growth in mungbean range from 27 to 100% (Madrid and Vega, 1971; AVRDC, 1976).

Plant density is one of the most important yield contributing characters 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.* (1992) obtained greater yield of mungbean at higher density grown during early kharif. Information on the effect of

* *Part of a thesis submitted by the senior author for the M. S. Degree at IPSA, Gazipur 1703, Bangladesh.*

mungbean plant density on competition with weed grown during late kharif is lacking in Bangladesh.

Critical period of weed competition is the period of crop life cycle within which a crop must be weeded to save the crop from ravages of weeds (Islam *et al.*, 1986). The critical period of weed competition in mungbean and the time of weed control for maximum yield is not yet known in Bangladesh. Therefore, this experiment was conducted to i) examine the effect of crop density and time of weeding on the yield and yield attributes of mungbean; and ii) quantify the relations of mungbean seed yield to mungbean plant biomass and weed biomass.

Materials and Methods

This experiment was conducted at the research farm of the Institute of Postgraduate Studies in Agriculture (IPSA), Salna, Gazipur (24° O'N and 90° 25'E) from September to December, 1992. The experimental plot was a high land with silty-clay loam of shallow red brown soil under Salna series having pH 6.5, CEC 25.8, OC 0.36% and C/N ratio 10.30 (Haider *et al.*, 1991).

Experimental procedure

Two plant densities, (33 and 50 plants/m^2) and eight times of weeding formed the treatments. Thirty three plants/m^2 was considered as 'optimum density' and 50 plants/m^2 as 'high density'. Times of weeding were weeding at 0, 7, 14, 21, 28, 35 and 42 days after emergence (DAE) and no-weeding (control). The treatments were arranged in split-plot design with three replications. Plant densities were assigned in the main plot and time of weeding in the sub-plots. The unit plot (sub-plot) size was 4m × 3m.

The experimental area was fertilized with 20-40-25 Kg N_2, P_2O_5, and K_2O/ha. The seeds of mungbean (cv. Kanti) were soaked in water for four hours prior to sowing. Two to three seeds per hill were sown on September 23, 1992 in rows 30 cm apart with 10 cm and 6 cm between seeds within row for obtaining 33 plants/m^2 and 50 plants/m^2, respectively. The seeds of mungbean emerged on September 27, 1992. The plants were thinned to one per hill at 7 DAE. Weeding was done twice in plots where weeding was scheduled up to 21 DAE, because appreciable weed re-infestation was observed in these plots within seven days after first weeding. Remaining treatments were weeded once. Weeds removed from plots were dried at 70°C and dry biomass of weed was recorded. For no-weeding treatment, weed biomass was recorded at harvest.

Data collection

For observations on the morphological characters and yield attributes, 10 mungbean plants were randomly selected during early pod forming stage from each plot and were tagged. Number of nodes/plant, pods/ plant and seeds /pod were recorded from these plants. An area of 3 m^2 was harvested from the centre of each plot. Dry biomass and seed yield of mungbean were recorded. Matured pods were harvested at 60, 68, and 74 DAE. Seed weight (g/1000 seeds) of individual plots was measured. Biomass of mungbean plants at maturity were recorded from 1 m^2 area. After final harvest, weeds found in the plots were collected and identified.Total dry biomass weights of weeds from successive weedings were recorded.

Analysis of variance (ANOVA) was performed on yield and yield attributes of mungbean. The means were separated and compared by LSD at 0.01% and 0.05 % level of significance. Linear regression models were developed on the relationship of seed yield with weed biomass and mungbean biomass. Correlation between planted and final density of mungbean was performed.

Results and Discussion

Floristic composition of weed species

Seventeen weed species were found in the experimental plots. More than 97% of the weed flora collected from the experimental plots was composed of *Cynodon dactylon, Cyperus rotundus, Echinochloa crusgalli, Fimbristylis limifloia, Eclipta prostrata, Cleome viscosa, Digitaria sanguinalis,* and *Enhydra fluctuns* (Table 1). *Cynodon dactylon* was the most dominant (33%) weed species in mungbean followed by *Cyperus rotundus* (21.05%), *Echinohloa crusgalli* (16.22%), *Fimbristylis limifolia* (10.36%), *Eclipta prostrata* (7.04%) and so on (Table 1). Other nine species viz., *Amaranthus viridis, Euphorbia thymefolia, Leptochola chinensis, Cyperus deformis, Cyperus miliacea, Jussia limifolia, Physalis heterophylla, Solanum torvum,* and *Portulaca oleracea*, were sporadically observed. The weed count of all the species was at least four times greater in the unweeded plots than in the weeded plots regardless of time of weeding except in case of few minor weeds. *Cynodon dactylon* was the most dominant in the unweeded plots and *Cyperus rotundus* was the most dominant in the weeded plots. The weed count in high density (50 plants/m^2) was 20% less than in optimum density (Table 1) and the weed biomass in high density was 16% lower than in optimum density (Table 2). It, thus, appears that reduction in weed count due to increase in crop density does not necessarily mean a proportionate reduction in weed biomass.

Weed biomass

Delay in weeding significantly increased dry weed biomass (Table 2). Weeding from emergence to 14 DAE produced similar dry biomass of weed. Weeding at 28 DAE or latter produced significantly higher dry biomass of weed than weeding at 21 DAE or earlier (Table 2). Significant interaction effect of crop density and time of weeding was found on dry weed biomass. Weed biomass increased with delay in time of weeding regardless of density of mungbean (Table 2). Weeding from emer-gence to 14 DAE produced similary dry weed biomass at both densities of mungbean. Weeding at 21 DAE or latter produced higher weed biomass than weeding at emergence or 7 DAE. Highest weed biomass was obtained in unweeded plots (170.00 g/m^2) or weeding at 42 DAE (166.67g/m^2) at the optimum density

Table 1. Floristic composition of weed species as recorded at final harvest in weeded and unweeded plots at optimum and high densities of mungbean.

Name of weed species	No. of weeds/m^2		% of total	No. of weeds/m^2 at	
	Weeded	Un-weeded		33 plants/m^2	50 plants/m^2
Cynodon dactylon	5.43	84.00	33.00	29.63	18.38
Cyperus rotundus	19.43	44.00	21.05	21.00	24.88
Echinochloa crusgalli	3.36	45.50	16.22	8.38	8.88
Fimbristylis limifolia	3.21	28.00	10.36	9.13	3.50
Eclipta prostata	1.71	19.50	7.04	4.50	3.38
Cleome viscosa	5.00	9.00	4.65	7.00	1.75
Digitaria sanguinalis	2.71	11.00	4.55	3.12	4.38
Enhydra fluctuns	3.93	5.50	3.13	3.25	3.00
Total	54.78	246.50	100	86.01	68.1

Table 2. Effect of crop density and time of weeding on the dry biomass weights of weeds.

Days after emergence of mungbean	Biomass of weeds (g/m^2)		
	33 plants/m^2 of mungbean	50 plants/m^2 of mungbean	Mean of densities
0	39.86 e	34.37 e	37.29 c
7	46.52 e	36.34 e	41.43 c
14	58.89 de	56.99 de	57.94 bc
21	78.47 d	74.64 d	76.56 b
28	129.17 bc	118.06 c	123.61 a
35	144.44 ab	135.03 bc	139.74 a
42	166.67 a	127.50 bc	147.08 a
No-weeding	170.00 a	140.12 bc	155.06 a
$LSD_{.01}$		25.10	

(Table 2). The weed biomass weights obtained at 42 DAE and no-weeding in the optimum density were higher than the dry biomass weights in the corresponding treatments in the high density. On the average, the dry weed weights in the high density was 13% lower than in the optimum density. However, the dry weed biomass as recorded up to 35 DAE in the optimum density were similar to those obtained from the corresponding treatments in the high density (Table 2). These results demonstrate that high density of mungbean suppressed weed growth by reducing weed biomass compared to the optimum density. However, the suppressive effect of density was evident only after 35 DAE. This is probably because that the leaf area index of mungbean reaches the maximum around 35 DAE when the plants are at flowering stage (Chaudhury, 1992).

Yield and yield attributes of mungbean

Plant density.

Final plant stands of mungbean in the optimum density (32.7 plants/m^2) was significantly lower than the high density (43.42 plants/m^2). The final densities were highly correlated to the planted densities (r=0.99). Time of weeding did not affect the final plant density of mungbean (Table 3). Plant density and time of weeding also did not interact to influence the final density of mungbean. About 14% mortality of plants was observed in high density. Hamid (1989) also found that mungbean grown at high density had a high rate of mortality.

Number of nodes/plant

Number of nodes/plant was not significantly influenced by density of mungbean. Mungbean density and time of weeding showed significant interaction effect on number of nodes/plant (Table 3). Highest number of nodes/plant (9.00) was found in the plants of optimum density weeded at emergence (0 DAE). In the optimum density, the plants weeded within 28 DAE had similar number of nodes/ plant to those weeded on 0 DAE. In the high density, number of nodes/plant were similar for all times of weeding. The lowest number of nodes/ plant (7.57) was found in the unweeded plants in the optimum density.

Table 3. Effect of crop density and time of weeding on yield and yield attributes of mungbean.

Time of Weeding (DAE)	Final plant density (No./m^2)		No. of nodes/ plant		No. of pods/ plant	Seed size (g/1000 seeds)	Yield (kg/ha)
	33 plants/m^2	50 plants/m^2	33 plants/m^2	50 plants/m^2			
0	32.67	43.00	9.00 a	7.57 def	18.80 a	34.46 a	1729 a
7	32.67	43.67	8.77 ab	7.63 f	18.53 a	34.40 ab	1703 a
14	33.00	43.67	8.60 ab	7.57 f	18.03 a	4.37 ab	1655 b
21	32.67	43.33	8.57 abc	7.9 ef	17.60 ab	34.21 b	1575 c
28	33.00	43.33	8.47 abcd	7.77 ef	17.40 ab	34.20 b	1522 d
35	32.67	43.00	8.22 bcde	7.77 ef	15.98 bc	33.88 c	1396 e
42	33.00	43.67	8.03 cdef	7.80 ef	14.41 cd	33.13 d	1223 f
No-weeding	32.00	43.67	7.57 f	7.63 f	13.82 d	32.58 e	1188 f
CV(%)	1.00		4.11		7.30	0.41	1.86
$LSD_{.05}$	NS		0.5291		1.960	0.219	44.43

Number of nodes in the high density were similar to the number of nodes/plant in the optimum density in no-weeding. On the average, the number of nodes in the high density were 8% less than the nodes/plant in the optimum density. Effect of time of weeding on number of nodes/ plant was not evident until 35 DAE.

Number of pods/plant

Time of weeding significantly affected number of pods/plant of mungbean (Table 3). Weeding from emergence to 21 DAE produced similar pods/plant. Delay in weeding up to 35 DAE reduced number of pods/plant compared to weeding up to 14 DAE. However, weeding at 42 DAE was no better than no-weeding in producing the number of pods/plant. Number of pods in unweeded plants was 26% less than the plants weeded on the day of emergence (Table 3). Kumar and Kairon (1988) found no influence of weeding on the pods/plant in mungbean.

Density and time of weeding interacted to influence number of pods/plant. Weeding even at 35 DAE produced higher number of pods/plant in the optimum density than the unweeded plants in the high density (Figure 1). In the optimum density, weeding by 21 DAE produced higher number of pods/plant than those weeded at 35 DAE. Number of pods/plant in the high density weeded up 28 DAE was lower than optimum density (Figure 1). Effect of density on the number of pods/ plant was apparently diminished after 28 DAE.

Seed size

Time of weeding significantly affected mungbean yield. Density did not affect seed size. Density and time of weeding also did not interact to influence the seed size. Mungbean seed size (g/1000 seed) decreases progressively with delay in weeding. Delay in weeding up to 21 DAE reduced seed size compared to weeding at emergence (Table 3). Delay in weeding beyond 28 DAE substantially reduced seed size of mungbean (Table 3).

Seed yield

Time of weeding significantly affected seed

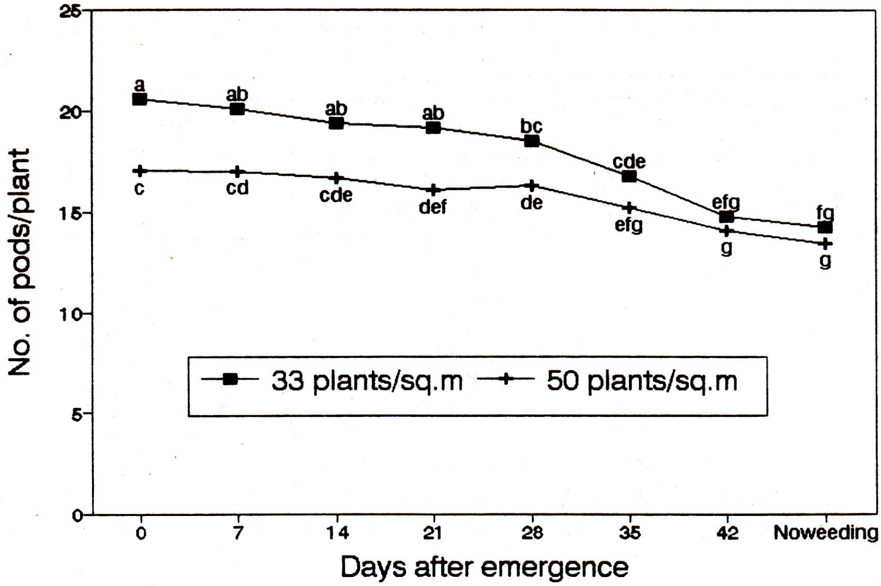

Fig. 1. Interaction effect of density and time of weeding on the number of pods per plant of mungbean.

yield of mungbean. Seed yield of mungbean decreased progressively with delay in weeding (Table 3) . Weeding at 0 and 7 DAE produced higher seed yield than weeding after 7 DAE. In other words, delay in weeding up to14 DAE significantly decreased mungbean seed yield compared to weeding at 0 or 7 DAE. This result demonstrates that critical period of weeding in mungbean may lie between 7 and 14 DAE. Weeding at 0 DAE in optimum density produced 46% higher seed yield than no-weeding (Table 3).

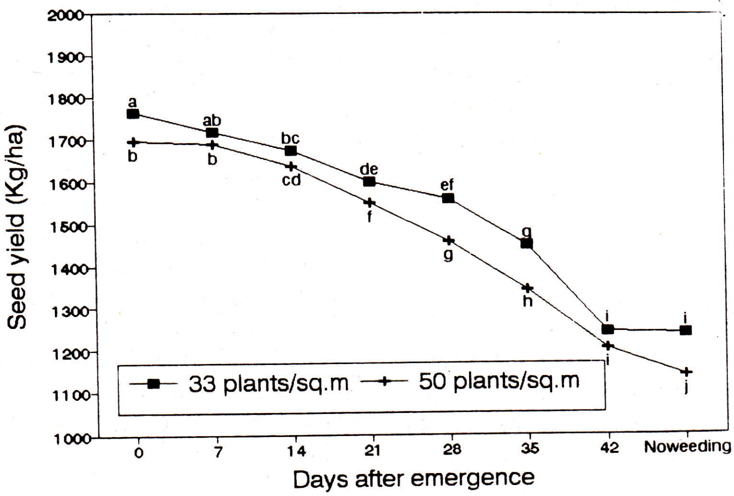

Fig. 2. Interaction effect of density and time of weeding on the seed yield of mungbean.

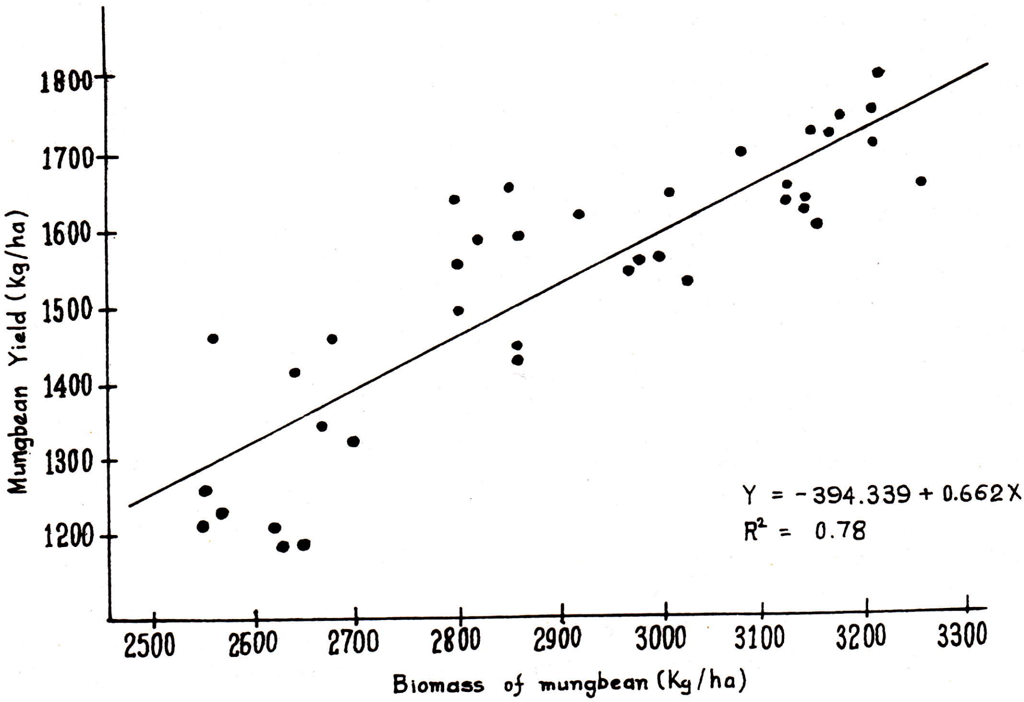

Fig. 3. Relationship of seed yield of mungbean to its total final dry biomass. In Y= – 394.33 + 0.662 X, Y is the yield of mungbean seed, X is the biomass of mungbean, and 394.33 and 0.662 are constants.

The density of mungbean and time of weeding significantly interacted to influence yield of mungbean (Figure 2). The highest yield (1762 kg/ha) was obtained when plants were weeded at emergence in optimum density and the lowest yield (1137 kg/ha) was obtained from no-weeding in high density. Increases in density decreased yield of mungbean. In unweeded plots, yield of mungbean was lower at high density than in optimum density indicating that intraspecific competition in mungbean is probably more deleterious to mungbean than interspecific ompetition with weeds. Ahmed *et al.* (1992) obtained higher yield in plots having 50 plants/m^2 weeded at 10 or 20 DAE of mungbean (cv. Mubarik) than in plots with 33 plants/m^2 during early Kharif season. However, the highest yield obtained by these authors was lower than the lowest yield obtained in this study. Mungbean seed yield was reduced up to 36% by weeds in this study. Sarker and Mondal (1985) also observed 49 to 55% yield reduction of mungbean when weeds were allowed to grow undisturbed. The extent of yield reduction due to weed could be 27 to 100% in mungbean depending on season or location (AVRDC,1976; Madrid and Vega, 1971). High density suppressed weed growth by13% compared to the optimum density. So, high density should result in higher seed yield in the unweeded plots. Such yield advantage due to weed suppression in high density was not realized in this study.

Predicting mungbean seed yield

Linear regression models were generated to predict yield of mungbean seed by biomass of mungbean or weeds. In the regression equation Y= -394.339 + 0.662 X (R^2 = 0.78) (Figure 3), Y is the predicted yield of mungbean seed and X is the biomass of mungbean. The slope 0.662 indicates that for one kg increase in mungbean biomass, he seed yield increases by 0.662 kg/ha within the linear part of the relationships. The R^2 explains that 78% of the total variation in yield of mungbean was explained by the mungbean biomass. The regression equation Y = 1852.535 - 0.395 X (R^2= 0.82) (Figure 4) expresses the relationship between dry weed biomass and seed yield of mungbean. The intercept indicates that the yield of mungbean should be 1852.535 (kg/ha) if there is no weed in the field. The slope (-0.359) indicates that for one kg/ha increase in weed biomass, the mungbean yield would decrease by 0.359 kg/ha. The R^2 demonstrates that 82% total variation in seed yield was explained by dry weed biomass alone. Both the regression equations were powerful in predicting the yield of mungbean. However, the pedictability of the equations may not hold good beyond the range of the data set.

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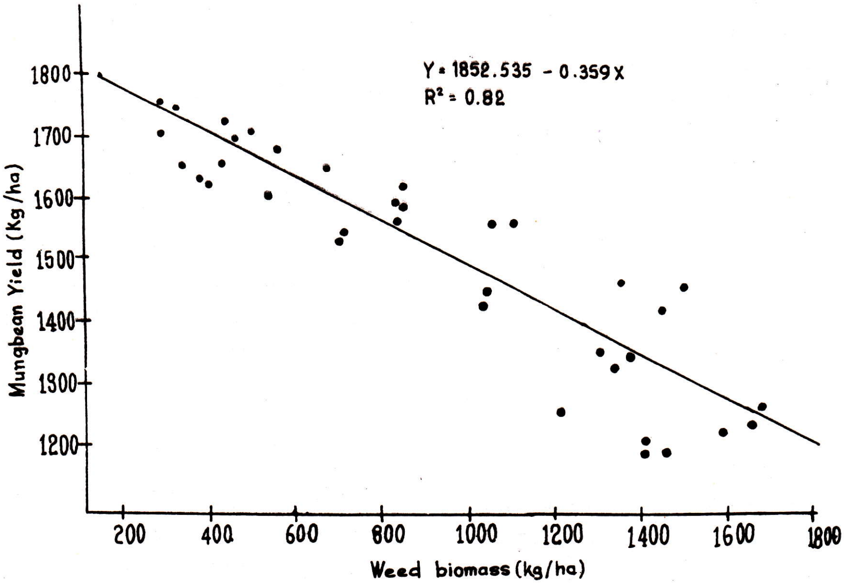

Fig. 4. Relationship of mungbean seed yield to the cumulative total final dry biomass of weeds. In Y=1852.35 – 0.359X, Y is the seed yield of mungbean, X is the dry weed biomass, and 1852.35 and 0.359 are constants.

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