Pak. J. Weed Sci. Res., 20(1): 59-66, 2014

EFFECT OF TILLAGE AND SOWING METHODS ON WEED BIOMASS AND MUNGBEAN YIELD UNDER IRRIGATED CONDITIONS

Mohammad Amin[1*], Mohammad Jamal Khan[2], Mohammad Tariq Jan[3], Nazir Ahmad[4], Masood ur Rehman[1] and Azhar Rauf[5]

ABSTRACT

A field experiment was conducted to find the effect of tillage practices and sowing methods on weed biomass, biological and grain yield of mungbean under irrigated conditions at the Research Farm of the University of Agriculture Peshawar, Pakistan during 2011. The experiment was conducted in a randomized complete block design with split plot arrangement and replicated four times. Tillage was assigned to main plots which consisted of tine cultivator twice (TC-2), farmer tillage practices, chisel plow (CR), mouldboard plow (MR), disc plow (DR) and tine cultivator (TCR) each followed by rotavator; while sowing methods consist of single box seed drill (SD), combined drill (CD) and broadcast (BC) allotted to sub plots. Statistical analysis of the data revealed that tillage practices had a significant effect on fresh and dry weed biomass and grain yield of mungbean. Similarly, sowing methods showed significant effect on weed biomass, biological and grain yield of mungbean. Minimum fresh and dry weed biomass (323 and 143 g m^{-2}) and maximum biological yield of 5253 kg ha^{-1}were recorded in plots plowed with MR tillage practices. While, maximum grain yield of 959 kg ha^{-1} was obtained with TCR tillage practices. Similarly, minimum weed biomass and maximum biological and grain yield of mungbean were recorded in plots of SD and CD sowing methods as compared to broadcast. Therefore, in order to reduce weed infestation in mungbean MR tillage practice and SD or CD sowing method should be used and for improving the biological and grain yields MR and TCR tillage in combination with CD or SD sowing method are best under irrigated condition of Peshawar in clay loam soils.

Key words: Mungbean, Peshawar, sowing methods, tillage, weeds, yield.

[1]Dept. of Agricultural Mechanization, [2]Dept. of Water Management, [3]Dept. of Agronomy, [4]Dept. of Animal Nutrition, The University of Agriculture Peshawar, Pakistan
[5] Department of Computer Sciences, University of Peshawar, Pakistan
*Corresponding author's email: dr.amin_mechanization@yahoo.com

Citation: Amin, M, M.J. Khan, M.T. Jan, N. Amad, M. Rehman and A. Rouf. 2014. Effect of tillage and sowing methods on weed biomass and mungbean yield under irrigated conditions. Pak. J. Weed Sci. Res. 20(1): 59-66.

INTRODUCTION

Mungbean (*Vigina radiate* L.) is an important legume crop cultivated in many Asian countries including Pakistan. It plays an important role in the national economy of the country. Weeds are one of the most restrictive factors in efficient crop production. Many efforts have been made to find out an economical weed control technology in areas where pulses are grown. The improvement in grain yield under different weed control methods may be attributed to more weed growth reduction, which favored number of pods plant^{-1}, seed pod^{-1} and thousand grain weight.

Tillage operations are generally performed to break the soil, allow the free movement of air and water remove weeds and provide a better environment for plant growth. Tillage plays an important role in controlling weeds and managing crop residues. Tillage after harvest of previous crops is usually performed by using primary tillage implements. Mouldboard plow is a common primary tillage implement for the use of inversion of the soil, burying of weeds and residues. Mouldboard plowing resulted in seed-bed with weed free condition and higher yield than direct seeding, as weed infestation was higher in direct seeding compared to the conventional method (Yalcin *et al.,* 2005). Marwat *et al*. (2007) reported that weed density was higher in reduced tillage practices than conventional tillage. Demjanova *et al.* (2009) reported that weed biomass was affected by tillage system, significantly less weed dry biomass was found in conventional tillage under mouldboard plowing as compared to reduced tillage practices.

Ozpinar (2006) reported that weed increased in intensive tillage compared to mouldboard plowing. Gruber and Claupein (2009) reported that mouldboard plowing resulted in lowest weed infestation and the highest weed infestation occurred in chisel plow treatment. The chisel plow is suitable for cutting the soil without complete burying or mixing of surface material. The chisel plow is considered as a potential conservation tillage method. Conservation tillage is not yet widely accepted by farmers because inversion tillage is considered to be necessary for weed control. Primary tillage by chisel plow resulted in significantly higher annual weed density compared to other tillage (Gruber and Claupein, 2009). Disk plow is suitable for the virgin, hard, stony and wet soil for cutting crop residues and partially inverted the soil. Secondary tillage includes the use of single or double passes of cultivator for preparing the seed bed (Boydas and Turgut, 2007). Tine

type cultivator is the common tillage implement used in Pakistan for primary tillage operation as well as for seed bed preparation in a variety of soils (Soomro *et al.,* 1985). Tine cultivator does not satisfy the proper tillage requirement, soil is lifted untilled between two consecutive tines and the farmers have to till the field repeatedly causing over tilling. Rotary tillers are increasingly used in various operations in agriculture; give high quality of soil cultivation, uniform mixing of soil with plant residues, weeds, organic and mineral fertilizers. Maximum yield produced from plot plowed with one pass of rotavator and cultivator (Manian *et al*., 1999; Iqbal *et al*., 2007).

The conventional sowing practices are one of the reasons for low crop yield in the country (Khan *et al.,* 1990). To mechanize sowing operation, a suitable drill should be used to place the seed and fertilizer in the zone of adequate moisture and at desired depth. Singh *et al.* (2007) reported that strip till drilling produced higher values of growth, yield attributing characters, grain and straw yield as compared to conventional sowing methods. Keeping in view the importance of tillage practices and sowing methods, the present research study was conducted to evaluate the performance of different tillage practices, sowing methods and their effect on weed biomass and yield of mungbean under irrigated condition.

MATERIALS AND METHODS

A field experiment was conducted to study the effect of different tillage practices and sowing methods on weeds biomass, biological and grain yield of mungbean at the New Developmental Agricultural Research Farm, The University of Agriculture Peshawar, in 2011. The experiment consisted of different tillage practices and various sowing methods. The experimental design, Randomize Complete Block design (RCBD) was used with a split plot arrangement. Tillage practices were assigned to main plots, while sowing methods to sub plots and replicated four times. Each main plot was divided into three sub plots for different sowing methods. For access of drills to each sub plot and turning of seed drills, 4.5 meters space at two spots were left in the middle of the main plots. The net sub plot size was 25 m long and 2.4 m wide (25m $\times$ 2.4m). The total numbers of the experimental subplots were 60. The total experiment area was 3600 m^2. The tillage implements combination used in the experiment were tine cultivator twice (TC-2), moldboard plow (MR), disk plow (DR), chisel plow (CR) and tine cultivator (TCR) each followed by a rotavator.

Sowing methods were single box seed drill (SD) combine drill (CD) and broadcast (BC). Locally made single box seed drill and combined drill (seed-cum-fertilizer drill) were adjusted and calibrated

before sowing of crop. Seed drills (SD) and combined drill (CD) were adjusted for 30 cm row to row distance and calibrated at the seed rate of 30 kg ha^{-1} for mungbean before sowing. For application of (DAP) fertilizer, combined drill was calibrated at the rate of 90 kg ha^{-1} while in the plots of seed drill and broadcast (DAP) fertilizer were applied by hand broadcast at the rate of 90 kg ha^{-1} before sowing. The data of fresh weed biomass were recorded after 40-50 days of mungbean sowing. Quadrate of (50 x 50) cm was randomly thrown in each sub plots and weeds inside the quadrate were taken out by hand. The weight of fresh weeds samples were taken with electronic balance in the laboratory and put in the oven for 72 hours at 65^0C, after that dry weed biomass were recorded and then converted to m^{-2}. Biological and grain yield of mungbean were recorded in each subplots by throwing one $meter^2$ frame and then harvesting the crop. Two samples from each subplot were collected, sun dried, weighed by spring balance and biological yield were recorded. The samples were then threshed separately for recording grain yield and then converted to kg ha^{-1}.

The data were subjected to analysis of variance (ANOVA) appropriate for Randomized Complete Block Design with the split plot arrangement by using computer software MSTATC and significant difference among the treatment means were identified by using LSD test at 5% level of probability subject to significant F-value as described by Steel and Torrie (1980).

RESULTS AND DISCUSSIONS

Fresh weed biomass (g m^{-2})

Analysis of variance for weed biomass revealed that effect on weed biomass of different tillage and sowing methods was significant. Mean fresh weed biomass with different tillage practices ranged from 323 to 798 g m^{-2} (Table-1). Lowest weed biomass of 323 g m^{-2} was noted when MR tillage practices was used, while highest of 798 g m^{-2} was obtained with TC-2 tillage practices. This could be due to the inversion of the soil and burying of weeds in the soil with the moldboard plowing. These results are in line with Khan *et al.* (1986) who reported that inversion of the soil by the moldboard plow reduced weed population. Khan *et al.* (1990) also reported that moldboard plow greatly reduces the weed population as compared to non inversion tillage implements. Marwat *et al.* (2007) reported that weed density was higher in reduced tillage as compared to conventional tillage. The average fresh weed biomass of different sowing methods ranged from 434 to 508 g m^{-2}. Highest fresh weed biomass (508 g m^{-2}) was obtained by BC sowing methods, while lowest weed biomass of 434 g m^{-2} was obtained in SD method of sowing.

Dry weed biomass (g m^{-2})

Data concerning dry weed biomass in mungbean is reported in Table-1. Analysis of variance for dry weed biomass revealed that effect on weed biomass of different tillage and sowing methods was significant. Dry weed biomass with different tillage practices ranged from 143 to 376 g m^{-2}. Lowest weed biomass of 143 g m^{-2} was noted when MR tillage practices was used, while highest of 376 g m^{-2} was obtained when TC-2 tillage practices were used. This may be due to the inversion of the soil and burying of weeds in the soil with the moldboard plowing. The results are in agreement Khan *et al.* (1990) who reported that moldboard plow greatly reduces the weed population as compared to non inversion tillage implements. Marwat *et al.* (2007) reported that weed density was higher in reduced tillage as compared to conventional tillage. Demejanova *et al.* (2009) reported that significantly less weed dry biomass were recorded in mouldboard plowing as compared to reduced tillage practices**.** The average values for dry weed biomass of different sowing methods ranged from 198 to 226 g m^{-2}. Highest dry weed biomass (226 g m^{-2}) was obtained by BC sowing methods, while lowest weed biomass of 198 g m^{-2} and 209 g m^{-2} was obtained when SD and CD method of sowing were used, respectively.

Table-1. Fresh and dry weed biomass (g m^{-2}) in mungbean plots as effected by different tillage practices and sowing methods in 2011

Tillage practices	FFFWBM(g m^{-2})	DWBM (g m^{-2})
TC-2	789 a	376 a
CR	428 bc	189 b
MR	323 c	143 c
DR	370 bc	154 bc
TCR	455 b	192 b
$LSD_{(0.05)}$	(69.70)	(38.50)
Sowing Methods (SM)		
Seed drill (SD)	434 b	198 b
Combined Drill (CD)	483 ab	209 ab
Broadcast (BC)	502 a	226 a
$LSD_{(0.05)}$	(66.21)	(25.67)

Biological yield (kg ha^{-1})

Analysis of variance for biological yield showed no significant difference for different tillage practices while sowing methods were significant. The biological yield due to different tillage practice was in the range of 4827-5253 kg ha^{-1}. Minimum biological yield of 4827 kg ha^{-1} was obtained when TC-2 tillage practices was used, while

maximum biological yield of 5253 kg ha^{-1} was recorded when MR tillage practices was used followed by TCR and DR with 5171 and 5109 kg ha^{-1} (Table-2)**.** Salahin *et al*. (2011) reported that tillage had no significant effect on biomass and straw yield of mungbean. Khan *et al.* (2011) reported that mouldboard plowing produced better results than cultivator. Average values for biological yield with different sowing methods ranged between 4591-5414 kg ha^{-1}. A maximum biological yield of 5414 kg ha^{-1} was obtained with SD sowing method followed by CD with 5196 kg ha^{-1}, while minimum (4591 kg ha^{-1}) was obtained when broadcast method of sowing was used. This may be due to the proper placement and covering of seeds by drill sowing methods, which provide better environment for plant growth and increased biological yield as compared to broadcast sowing.

Grain yield (kg ha^{-1})

Analysis of variance showed that the effect of both tillage practices and sowing methods on grain yield of mungbean was significant. The average grain yield ranged from 748 to 959 kg ha^{-1} with different tillage practices (Table-2). The maximum grain yield of 959 kg ha^{-1} was obtained with TCR tillage which was followed closely by DR, CR and MR tillage practices. The lower grain yield of 746 kg ha^{-1} was obtained with TC-2 tillage practices. This may be due to the better pulverization of soil by rotavator with combination of other tillage implements which provided better environment for growth and ultimately increased grain yield. Khan *et al.* (1986; 1990) reported that moldboard plow give significantly higher grain yield than cultivator. Iqbal *et al.* (2007) also reported that maximum grain yield was obtained from one pass of rotavator and one pass of cultivator. However, Salahin *et al*. (2011) reported that tillage had no significant effect on crop yield of mungbean. Regarding sowing methods mean grain yield of mungbean ranged from 606 to 1008 kg ha^{-1}. Higher grain yield of 1008 kg ha^{-1} was recorded when combined drill (CD) was used followed by seed drill (SD) with 997 kg ha^{-1}, while lower grain yield 606 kg ha^{-1} was obtained when broadcast (BC) method of sowing was used. This may be due to uniform and proper placement of seed by drill sowing methods. Singh *et al.* (2007) found that drilling produced a higher grain yield than conventional sowing method. Khan *et al.* (1990) reported broadcast sowing is one of the reasons for low crop yield in the country which needs to be reflected with drill sowing for better productivity.

Table-2. Biological and grain yield kg ha^{-1} of mungbean as effected by different tillage practices and sowing methods in 2011

Tillage practices	Biological yield kg ha^{-1}	Yield kg ha^{-1}
TC-2	4827	748 b
CR	4986	880 ab
MR	5253	874 ab
DR	5109	889 ab
TCR	5171	959 a
$LSD_{(0.05)}$	(355)	(199)
Sowing Methods (SM)		
Seed drill (SD)	5414 a	997 a
Combined Drill (CD)	5196 a	1008 a
Broadcast (BC)	4591 b	606 b
$LSD_{(0.05)}$	(334)	(140)

CONCLUSION

It is concluded from the results that tillage practices significantly affected the weed biomass and grain yield of mungbean. Weed biomass was greatly minimized by MR tillage practices and mungbrean grain yield was increased by TCR tillage practices. On the other hand, the mungbean biological and grain yield enhanced by drill sowing method. Therefore MR and TCR tillage practices and drill sowing methods should be used under irrigated conditions of Peshawar for minimizing the weed biomass and maximizing the yield of mungbean.

ACKNOWLEDGMENT

The support of the University of Agriculture Peshawar for facilitating the research is highly appreciated.

REFERENCES CITED

Boydas, M.G. and N. Turgut. 2007. Effect of tillage implements and operating speeds on soil physical properties and wheat emergence. Turk J. Agri. For. 31: 399-412.

Demjanova, E., M. Macak, I. Dalovic, F. Majernik, S. Tyre and J. Smatana. 2009. Effects of tillage systems and crop rotation on weed density, weed species composition and weed biomass in maize. Agron. Res. 7: 785-792.

Gruber, S. and W. Claupein. 2009. Effect of tillage intensity on weed infestation in organic farming. Soil Till. Res. 105: 104-111.

Iqbal, M., M. Ahmad, M. Ahmad, M. Iqbal and M. Ali. 2007. Wheat response to tillage and irrigation. Pak. J. Agri. Sci. 44: 164-167.

Khan, A.S., M.A. Tabassum and J. Khan. 1990. Selection of seed-cum-fertilizer drill: technical consideration. Agri. Mech. Asia. 21: 35-39.

Khan, B. M., A. Razzaq, B.R. Khan, K. Saeed, P.R. Hobbs and N.I. Hashmi. 1990. Effect of deep tillage on grain yield of wheat under rain fed conditions. Pak. J. Agri. Res. 11: 78- 83.

Khan, B.R., B. Khan, A. Razzaq, M. Munir, S.Ahamd, N.I. Hashmi and P.R. Hobbs. 1986. Effect of different tillage implements on the yield of wheat. Pak. J. Agri. Res. 7: 141- 161.

Khan, R.U., A. Rashid, M.S. Khan and A. Shah. 2011. Impact of tillage practices on growth and seed yield of mungbean (*Vigna radiata* L.) under rainfed conditions. J. Agric. Res. 49: 195-201.

Manian, M., G.B. Meenakshi and D.K. Kathirvel. 1999. Influence of deep tillage on in-situ moisture conservation in dry farming. AMA 30: 16-21.

Marwat, K.B., M. Arif and M.A. Khan. 2007. Effect of tillage and Zinc application methods on weeds and yield of maize. Pak. J. Bot. 39: 1583-1591.

Ozpinar, S. 2006. Effects of tillage systems on weed population on economics for winter wheat production under the Meiterranean dry land conditions. Soil Till. Res. 87: 1-8.

Salahin, N., M.S. Islam, R.A. Begum, M.K. Alam and K.M.F. Hossain. 2011. Effect of tillage and integrated nutrient management on soil physical properties and yield under tomato-mungbean-T.amancropping pattern. Int. J. Sustain. Crop Prod. 6: 58-62.

Singh, K.K., A.S. Jat and S.K. Sharma. 2007. Tillage and planting management for improving the productivity and profitability of rice-wheat cropping system. AMA. 38: 72-76.

Soomro, M.S., G.A. Shah, S.B. Bukhari and A.M. Chachar. 1985. Effect of tine spacing on the performance of Cultivator. Pak. J. Agri. Sci. 1: 121-126.

Steel, R.G.D. and J.H. Torrie. 1980. Principal and procedure of Statistic. A Biometrical approach. Mc Grow Hill. New York, NY, 2nd ed.p.633.

Yalcin, H., E. Cakir and E. Aykas. 2005. Tillage parameters and economic analysis of direct seeding minimum and conventional tillage in wheat. J. Agron. 4: 329-332.