Pak. J. Weed Sci. Res. 18(1): 71-78, 2012

EFFECT OF DIFFERENT WEED CONTROL METHODS ON WEEDS AND YIELD OF CHILLIES (*Capsicum annuum* L.)

Abid Khan[1], Muhammad Sajid[1], Zahid Hussain[2] and Abdul Mateen Khattak[1]

ABSTRACT

To study the effect of different weed control practices on weeds and growth of chillies, an experiment was carried out at Agriculture Extension Department, Dargai Malakand, Khyber Pakhtunkhwa Pakistan during 2011. The experiment was laid out in a randomized complete block design keeping three replications, and comprising of six treatments such as sorghum, wheat straw, and news papers as organic mulches, whereas black plastic as an inorganic mulch, in addition to a hand weeding and a weedy check. Chilli variety "Long Green" was selected for the experiment and sown in a plot size of 2.4 m x 3 m. All the treatments significantly affected the parameters of weed density m^{-2}, fresh and dry weeds biomass; and yield components of chillies such as number of fruits $plant^{-1}$, fruit length and economic yield. Highest weed density of 92 plants m^{-2}, fresh weed biomass of 1987 kg ha^{-1} and dry weed biomass of 1041 kg ha^{-1} were recorded in the weedy check plots, and the values were statistically at par with those of wheat straw (73 plants m^{-2}, 1521 kg and 890 kg ha^{-1}, respectively) and news paper treatments (83 plants m^{-2}, 1421 kg and 890 kg ha^{-1}, respectively) bith used as organic mulches. Hand weeding resulted in the highest number of fruits $plant^{-1}$ (58.1), fruit length (6.8 cm) and yield of chilli (8775 kg ha^{-1}). Therefore, hand weeding resulted as the most effective treatment in terms of weeds suppression and yield enhancement of chilli crop.

Key words: *Capsicum annuum*, chilli, hand weeding, mulching, weeds, yield.

INTRODUCTION

Chilli (*Capsicum annuum* L.) belongs to the family solanaceae, and is cultivated as an annual crop world wide. Chilli varieties are generally classified on fruit characteristics, i.e. color, pungency, flavor, shape, size and use (Smith *et al.,* 1987). Chillies are an excellent source of vitamin A and C, also called capsule of vitamin C and

[1] Department of Horticulture, [2]Department of Weed Science, Khyber Pakhtunkhwa Agricultural University Peshawar, 25130 Pakistan. Correspondence email: abidagriculturist@gmail.com

contain appreciable amount of calcium, phosphorus and iron. Chili heat (pungency) is due to capsaicin ($C_9H_{14}O_2$) which is a complex of seven closely related alkaloids or capsaicinoids (Bosland, 1992).

Immediately after transplanting, the pepper seedlings grow slowly and are very weak competitors for limiting resources against the weeds (Isik *et al.*, 2009). Furthermore, the over irrigation after crop transplanting stimulates a rapid weed growth, resulting in yield losses at harvest up to 97% (Amador-Ramirez, 2002). For these reasons weed control is recognized as the foremost production-related problem in both conventional and organic pepper crops (Amador-Ramirez *et al.*, 2007; Isik *et al.*, 2009; Younesabadi, 2006). In conventional cropping systems, herbicides have gradually replaced tillage for controlling undesirable vegetation (Sprague, 1986), in spite of issues related to the environment (Hallberg, 1989).

Chillies are produced well when it is adequately supplied with the essential nutrients (Alabi, 2006; Peck and MacDonald, 1975). Locassio *et al.* (1981) and Kulvinder *et al*. (1990) reported that yield in pepper increased with increase in nitrogen level. However, Batal and Smittle (1981) reported a decline in yield with high levels of N. It is well established that N influences the growth and development of pepper grown for its fruit (Mavengahama *et al.*, 2003). The overall effect would depend on the available N in the soil, in addition to the amount of nitrogen that is applied (Payero and Bhangoo, 1990).

Capsicums and chillies are grown from transplants commercially throughout Pakistan. Effective weed management strategies are limited for capsicum and chilli producers. Current weed control practices include the use of plastic mulch, selective grass herbicides, hand weeding or tillage practices. There are currently no herbicides registered for broadleaf weed control in capsicums or chillies. The development of effective broadleaf weed herbicides, to be used as part of an integrated weed management program in capsicum and chilli production in Pakistan is essential. In contrary, there are a number of non chemical ways to control weeds; however looking at the economics of the concerned farmers and quick action for a weed free environment, the chemical weed control method is still very popular in developing countries. The cultural methods are described to be useful for safe environment but are getting expensive, laborious and time consuming. However, the environmental safety and integrity can not be ignored. Therefore, implementing an integrated pest management (IPM) program is the best way to meet weeds head on. An IPM program will operate a multi-faceted plan of attack including herbicides use, removing some of the stubborn ones by hand and exploiting other weed control tools for an all encompassing and environmentally sound weed control program (Weber *et al.*, 1995; Shaikh *et al.*, 2004). The most critical period of weed competition is during the first four to six

weeks after emergence of the crop (Zafar *et al.*, 1981). If crops are kept weed-free during the early stages, yields will not be affected significantly. Although early weeding is critical to producing a good yield, late control is also important in preventing the weeds from flowering and producing seeds, which would affect the crop and increase weed load in subsequent seasons.

Keeping in view the importance of losses due to weeds in chilli crop, this instant study was designed for the development of an integrated weed control system in Chilli using organic and inorganic mulches.

MATERIALS AND METHODS

To study the effect of different non chemical weed control methods on weeds and yield of chillies, an experiment was conducted at Agricultural Extension Department Dargai Malakand in the summer season of 2011. The experiment encompassed six treatments which were, black plastic as an inorganic mulch treatment, and sorghum straw, wheat straw, and news papers as organic mulches, in addition to hand weeding and a weedy check (control) treatments. The experiment was laid out in a randomized complete block design having three replications.

Chillies variety "Long green" was transplanted after 30 days with row to row and plant to plant distances of 60 and 30 cm, respectively. For fertilizers, the urea was used as a source of nitrogen and DAP was used as phosphorus source. Nitrogen was applied in two splits (half at transplanting time and half after 30 days of transplanting) at the rate of 120 kg ha^{-1}. Black plastic and newspapers were kept between chilli rows soon after the transplantation process and small stones were kept on the surface of the black plastic and news papers in order to avoid removal of the applied materials by wind blow. Sorghum stalks were kept between the chilli rows and soil surface was completely covered to inhibit light for the germinating weeds seeds. In another treatment, soil surface between chilli rows was covered by wheat straw as a mulching technique. Data were recorded on weeds density m^{-2}, fresh and dry weeds biomass (kg ha^{-1}), fruit length (cm), fruits $plant^{-1}$ and yield (kg ha^{-1}). Weed density was recorded at 40 days after transplantation (DAT) from randomly selected three central rows from each experimental unit and was averaged to get weeds density m^{-2}. Fresh and oven dry weeds biomass of the samples were also recorded. Average fruit length was taken by measuring the fruit picked from five randomly selected plants and their average was calculated. Five plants were selected at random in each plot and tagged. The total numbers of fruits obtained from the selected plants were divided by 5 to get the average number of fruit $plant^{-1}$. Yield ha^{-1} was worked out by the following formula:

$$\text{Yield ha}^{-1} = \frac{\text{Yield plot}^{-1}\ (\text{kg})}{\text{Area of plot}\ (\text{m}^2)} \times 10000\ \text{m}^2$$

Statistical analysis

Data collected were analyzed statistically according to the procedures relevant to RCB design with split plot arrangement. Upon significant results, least significance difference (LSD) test was used for means comparisons to identify the significant components of the treatment means (Jan *et al.,* 2009).

RESULTS AND DISCUSSION

Weed density (m^{-2})

The weed control treatments significantly affected weed density m^{-2} (Table1). Higher weeds population was observed in weedy check plots (92 weeds m^{-2}) whereas hand weeding treatments resulted in lower weed population (35.7) followed by sorghum as organic mulch (41.3), which was however at par with the black plastic as inorganic mulch (45.7 weeds m^{-2}). The higher weeds density in weedy check plots may be attributed to the open soil surface and niches available to weeds for free and aggressive growth. Timely weeding in hand weeded plots might be the possible reason for lower weeds population in these plots. These results are also in accordance with those of Fathi *et al.* (2003), Hassan *et al*. (1995), and Hassan and Ahmad (2005) who alos found highest number of weeds m^{-2} in weedy check plots and lowest in hand weeded treatments.

Fresh and dry weed biomass (kg ha^{-1})

Weeds fresh and dry biomass was significantly reduced by hand weeding and sorghum mulch (Table-1). Highest fresh weed biomass (1987 kg) and dry weed biomass (1041 kg ha^{-1}) was recorded in weedy check plots wherase lowest weed fresh biomass (761 kg) and dry weed biomass (580 kg ha^{-1}) were recorded in hand weeded treatments. Timely eradication of weeds in hand weeding plots could be the possible reason for lower weeds fresh biomass in theses plots. Similarly, the allelopathic effect of sorghum mulch might have inhibited the weed seeds germination which at the end of the day resulted in less fresh and dry weed biomass. Weeds were effectively controlled in hand weeding and black plastic mulched plots. The weeds in the hand weeding plots were destroyed through weeding twice; in black plastic mulch weeds seeds might have failed to germinate due to lake of light and rise in temperature under black plastic. Syawal (1998) and Khan *et al.* (1998) also reported that hand weeding is the most effective weed control method. Unger and Ackermann (1992) reported that cover crops (live mulches) reduced weed biomass from 41 to 94%. Moreover, Gul *et al.* (2011) revealed that weed fresh

biomass was significantly lower in hand weeding plots due to the removal of weed density at early stage of the crop.

Table-1. Weed density, fresh and dry weed biomass as affected by different weed control treatments.

Treatments	Weeds density m^{-2}	Fresh weeds biomass (kg ha^{-1})	Dry weeds biomass (kg ha^{-1})
Weed Check	92.0 a	1987 a	1041 a
Hand Weeding	35.7 c	761 d	580d
Sorghum as mulch	41.3 c	923 d	595 d
Wheat Straw as mulch	73.0 b	1521 b	890 b
News Paper as mulch	83.0 ab	1421 b	890 b
Black Plastic as mulch	45.7 c	1188 c	690 c
LSD	15.10	176.2	194.6

Means followed by different letters are different statistically at 5% level of probability

Number of fruits $plant^{-1}$

The number of fruit $plant^{-1}$ were significantly ($P \leq 0.05$) affected by weed control methods (Table-2). The means analyses showed that higher number of fruits $plant^{-1}$ (58.1) were recorded in hand weeding plots, followed by sorghum mulch (52.5) and minimum (31.9) was recorded from control plots in which there was no weeding done. The decrease in the number of fruits $plant^{-1}$ in weedy check plots might be due to the increased competition for moisture, light and nutrients. Firthermore, the decrease in fruits $plant^{-1}$ was proportional to duration of weeds competition. Higher fruits $plant^{-1}$ in weed control plots than weedy check might be due to better growth and development of chillies plants and availability of more resources which resulted in more fruit production in chillies plant. The results are in agreement with those of Dennis *et al.* (1989) who reported that weed control through mulch has increased the number of fruits per plant.

Fruit length (cm)

Data pertaining fruit length (cm) is presented in Table-2. Mediation of the data for fruit length specify that different weeds control methods caused significant variation in fruit length of chilli. Higher fruit length (6.80 cm) was recorded from hand weeded plots which was followed by sorghum mulch plots (5.93 cm) while minimum (4.62 cm) was recorded from weedy check plots. Less competition for available resources like nutrients, light and space might be possible reason for increasing biological yield in the respective plots. Same results were obtained by Hassan *et al.* (1995) who reported increase in fruit length of chillies due to weed control measures.

Yield (kg ha^{-1})

Yield is the outcome of various yield components that were significantly ($P \leq 0.05$) affected by different weeds control methods (Table-2). Statistical analysis of the data indicated the hand weeding

resulted in highest yield (8875 kg ha^{-1}) which was followed by sorghum mulch (7802 kg ha^{-1}) while minimum (5269 kg ha^{-1}) was recorded from weedy check plots. Less competition for nutrients and other available resources in hand weeding plots resulted in higher yield of chilli in these plots. Our results are confirmed by the findings of Chalfant *et al.* (1977) who found that due to weed control yield increase may be attributed to more favorable soil moisture and nutrient utilization. Siborlabane (2000) also pointed out that the yield and quality of the fruit for tomato market varies according to the type of mulch used on the plantation.

Table-2. Fruits $plant^{-1}$, fruits length and yield (kg ha^{-1}) of chillies as affected by different weed control treatments.

Treatments	Fruits $plant^{-1}$	Fruit length (cm)	Yield (kg ha^{-1})
Weed Check	31.9 e	4.62f	5269 e
Hand Weeding	58.1 a	6.80a	8755 a
Sorghum as mulch	52.5 b	5.93b	7802b
Wheat Straw as mulch	39.1 d	4.9 e	6077 d
News Paper as mulch	41.8c	5.28c	7813b
Black Plastic as mulch	42.2c	5.20d	6179 c
LSD	1.3015	0.0359	92.469

CONCLUSION

Hand weeding has been the most effective weed control mwthod in enhancing all the growth and yield parameters of chilli. The weed density m^{-2}, fresh and dry weed biomasses were drastically reduced as compared to weedy check. Similarly, the number of fruits $plant^{-1}$, fruit length and yield of chilli were also the highest in hand weeding treatments. Therefore, hand weeding should be done in the vegetable crops like chillies at least twice in the full growing season, and also it should be a part of the integrated weed management program along with the mulching treatments, that were statistically at par with the hand weeding in the experiment. Looking at the cost of crop production mulching as well should be encouraged in the future weed management strategies.

REFERENCES CITED

Alabi, D.A. 2006. Effects of fertilizer phosphorus and poultry droppings treatments on growth and nutrient components of pepper (*Capsicum annuum* L). African J. Biotechnol. 5: 671-677.

Amador-Ramirez, M.D. 2002. Critical period of weed control in transplanted chilli pepper. J. Weed Res. 42: 203–209.

Amador-Ramirez, M.D., F. Mojarro-Davila and R. Velasquez-Valle. 2007. Efficacy and economics of weed control for dry chili pepper. J. Crop Prot. 26: 677-682.

Batal, K.M. and D.A. Smittle. 1981. Response of bell pepper to irrigation, nitrogen and plant population. J. American Soc. Hort. Sci. 106: 259-262.

Bosland, P.W. 1992. Chillies a diverse crop. Hort. Technol. 2(1): 7-10.

Chalfant, R.B., C.A. Jaworski, A.W. Johnson and N.R. Sumner. 1977. Reflective film mulches, millet barriers, and pesticides: Effects on watennelon mosaic virus, insects, nematodes, soil borne fungi, and yield of yellow summer squash. J. American Soc. Horti. Sci. 102: 11-15

Dennis, R.D., J.K. Michael and G.H. Patrick. 1989. Mulch surface color affects yield of fresh market tomatoes. J. American Soc. Horti. Sci. 114: 217-219.

Fathi, G., F. Ebrahimpoor and S.A. Siadat. 2003. Efficiency of single and integrated methods (chemical-mechanical) for weed control in Corn SC704 in Ahvaz climatic conditions. Iran. J. Agri. Sci. 34 (10): 187-197.

Gul, B., K.B. Marwat, M. Saeed and Z. Hussain. 2011. Impact of tillage, plant population and mulches on weed management and grain yield of maize. Pak. J. Bot. 43(3): 1603-1606.

Hallberg, G.R. 1989. Pesticide pollution of ground water in the humid United States. Agric. Ecosyst. Environ. 26: 299-367.

Hassan, S.A., R.Z Abidin and M.F. Ramlan. 1995. Growth and yield of chilli (*Capsicum annuum* L.) in response to mulching and potassium fertilization. Universiti Pertanian Malaysia.

Hassan, A.A.A. and M.K.A. Ahmed. 2005. The influence of some herbicides and additional hoeing in maize growth and yield and yield components. Int. J. Agric. Biol. 7(5): 708-711.

Isik, D., E. Kaya, M. Ngouajio and H. Mennan. 2009. Weed suppression in organic pepper (*Capsicum annum* L.) with winter cover crops. Crop Prot. 28: 356-363.

Jan, M.T., P. Shah, P.A. Hollington, M.J. Khan and Q. Sohail. 2009. Agriculture Research: Design and Analysis, A Monograph. NWFP Agric. Univ. Pesh. Pak.

Khan, S.A., N. Hussain, I.A. Khan, M. Khan and M. Iqbal. 1998. Study on weeds control in maize. Sarhad. J. Agric. 14(6): 581- 586.

Kulvinder, S., B.K. Srivastava, and K.S. Singh. 1990. Effect of various levels of nitrogen and phosphorus on growth and yield of chilli. Indian J. Hort. 45: 319-324.

Locassio, S.J.F., G.A. Kell and F.G. Martin. 1981. Response of Bell pepper to nitrogen source. J. American Soc. Hort. Sci. 106: 625-632.

Mavengahama, S., V.B. Ogunlela and D.I.K. Mariga. 2003. Response of paprika (*Capsicum annuum* L.) to different basal fertilizers. African Crop Sci. Conf. Proc. 6: 9-13.

Payero, J.O. and M.S. Bhangoo. 1990. Nitrogen fertilizer management practices to enhance seed production by 'Anaheim Chili' peppers. J. American Soc. Hort. Sci. 115: 245-251.

Peck, N.H. and G.E. MacDonald. 1975. Plant response to concentrated superphosphate KCl fertilizer for sweat corn (*Zea mays* L.) var. rugosa. New York State Experimental Station Search. 2: 1-8.

Shaikh, M.A., A. Saleem, N.A. Malik and M.A. Shahzad. 2004. Assessment of weed complex in spring potato fields of Mix-Cropping system under irrigated conditions of Faisalabad District. Pak. J. Weed Sci. Res. 10(1-2):63-72.

Siborlabane, C. 2000. Effect of mulching on yield and Quality on Fresh Market Tomato. Pages 1-5. *In*: Training Report 2000. Training Course in Vegetable Production and Research. ARC-AVRDC. Nakhon Pathom, Thailand.

Smith, P.G., B. Vilalon and P.L. Vila. 1987. Horticultural classification of pepper grown in United States. Hort. Sci. 22: 11-13.

Sprague, M.A. 1986. Overview. *In*: Sprague, M.A., Triplett, G.B. (Eds.), No Tillage and Surface Tillage Agriculture. Wiley, New York, pp. 1-18.

Syawal, Y. 1998. Composition shift and other characteristics of weeds and yield of sweet corn on Andisols with N fertilization and weeding at critical period of the crop. Publikasi Berkala Penelitian Pascasarjana Uni. Padjadjaran. 9(2): 18-33.

Unger, J. and R. Ackermann. 1992. Structure, dynamics and competitive effects of a natural weed community during the change of conventional to conservation tillage in maize production of the Leipzig lowland. Zeitschrift fuer Pflanzenkrankheiten und Pflanzenschutz. 13: 277-283.

Weber, G., K. Elemo and S.T.O. Lagoke. 1995. Weed communities in intensified cereal-based cropping systems of the northern Guinea savanna. Weed Res. 35: 167–178.

Younesabadi, M., A.S. Najad, A.R.S. Najad and H.O. Kashiri. 2006. Effect of climatic conditions on weed frequency of wheat fields and comparison of Golestan province cities by cluster analysis. Pak. J. Weed Sci. Res. 12(1-2): 7-12.

Zafar, M.I., R. Anwar and A.R. Saleemi. 1981. Effectiveness of chemical weed control in maize production. Pak. J. Agric. Res. 2(1): 21-23.