Journal of
Innovative Agriculture

Research Article
DOI: https://doi.org/10.37446/jinagri/rsa/9.4.2022.32-43

Effect of weed management practices on chilli yield in chattogram hill districts of bangladesh

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Received: 26 July 2022
Accepted: 13 November2022
Published: 31 December 2022

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Volume: 9
Issue: 4
Pages: 32-43

In Bangladesh during 2017-2018 was conducted in a farmer's field of the Chattogram hill districts to determine the effectiveness of different weed control strategies for weed control of transplanted chilli. The dry weight of weeds, weed control efficiency, weed index, and yield components like the number of fruits per plant, fruit length, fruit weight, and marketable fruit yield, had been significantly affected by using weed control measures. In the act of weed treatment in chilli fields, hand weeding+mulching also gave the highest weed control efficiency at harvest (89.19% in Khagrachari, 89.82% in Rangamati and 90.02% in Bandarban, respectively), the number of fruits per plant (130.40 in Khagrachari, 126.70 in Rangamati and 135.40 in Bandarban, respectively), fruit length (7.20 cm in Khagrachari, 7.00 cm in Rangamati and 7.10 cm in Bandarban, respectively), fruit weight (2.00g in Khagrachari, 2.10g in Rangamati and 2.20g in Bandarban, respectively) and marketable fruit yield (11.58 t/ha in Khagrachari, 11.64 t/ha in Rangamati and 11.96 t/ha in Bandarban, respectively) are the highest, while the weed index (3.90% in Khagrachari, 4.04% in Rangamati and 2.68% in Bandarban, respectively), is the lowest for hand weeding and mulching treatment compared with other treatments. Along these lines, chilli production in the hill districts of Chattogram was deemed to be the best eco-friendly and effective weed control strategy for hand weeding+mulching treatment.

Key words: *chilli, weed control efficiency, hand weeding, mulching, weed index, yield*

INTRODUCTION

Chilli pepper (*Capsicum frutescens* L.) is an important spice and fruit vegetable in the tropics and the second most important vegetable after tomatoes (*Solanum lycopersicum* L.) (Olaniyi and Ojetayo 2010). It is grown almost everywhere in humid and semiarid tropics as a main crop or as an intercrop with maize (*Zea mays* L.), yam (*Dioscorea alata* L.), cowpea (*Vigna unguiculata* (L.) Walp.), and cassava (*Manihot esculenta* Crantz.) (Salau et al., 2018). Chilli is an annual plant of the Solanaceae family (Islam et al., 2010) that grows in Central America, more specifically in Mexico, and is considered a recognized plant species first domesticated plant in America (De Lannoy, 2001). Chillies are now widely grown in the warmer tropical, subtropical and temperate regions of the first World (George, 1985). Chilli grows best in relatively warm climates at 18-27°C and is prone to frost. (Udoh et al., 2005). In 2012, the global production of fresh chilli was 31.2 million tons, with an estimated area of 2.0 million ha of land (FAOSTAT, 2013). China, Mexico, and Turkey were the top three producers of fresh chilli in the world in 2012, with production volumes of 16. Chilli is a far necessity spice crops in many countries around the world (BBS, 2005). Thirty-two (32) local varieties are grown in Bangladesh (BBS, 2005). Bangladesh's average yield of chilli peppers is quite moderate compare to other pepper-producing countries in the Globe (FAO, 2003), because of capricious rainfall and fertilizer use that is inadequate. Compared to most other field crops, weed management in chili pepper is much more demanding (Adigun et al. 2018).

Chilli yield consequence have been recital to overspread anything from 60-70%, with venerate to the elasticity and intensity combined with weed growth (Khan et al. 2012). Recent studies have shown that integrating hand weeding and herbicide application improved weed control efficiency and enhanced crop growth (Hajebi et al., 2016; Daramola et al., 2020), thereby increasing the crop yield. In general, weeds compete with crops, reducing yields and crop quality. Weeds can also provide shelter from pests and diseases (Chandran & Jett, 2009). A layer of natural organic mulch such as straw, in addition to controlling weeds, also maintains soil moisture and adds organic matter to it. Weed control can also be achieved through the use of various herbicides. Weeds can be controlled by physical or chemical methods (Chandran & Jett, 2009). However, effective weed control on peppers must begin before planting (Bullock, 2011). Integrated weed management is contemplation of as a process of weed control that composition in a diversity of ways to impair apprehension circularly weed populations and refute top emulation (Smith et al. 2010). According to Swanton et al. (2008) incorporated weed management is a coming that is a notice-supported mow fruit technique that must determinately be accomplish and devoted to yield sanity, while built-up-in clothing government has emerged into the underbrush technology participation (Hamill et al., 2004). A number of measure techniques such as for instance chemical, mechanical, and companionable are employment, nevertheless, they rarely give respect to remedy plants at separate set of the year or higher several seasons. Despite being the matter of some respectable study (Van Evert et al., 2011). In the case of herbicides, most of the research has focused on reducing costs by applying a small amount, overexposing stocks, or changing the application rates (Riar et al., 2011). This study was conducted to investigate the best ecological weed control measures for chilli production in the Chattogram hill districts of Bangladesh.

MATERIALS AND METHODS

The experiment was performed through the entire Rabi season in a farmer's field of the Chattogram hill districts in Bangladesh during 2017-2018 on chilli (*Capsicum* sp.). The research area was selected predicated on looking at the trail that is sufficient, farmer's perspectives on cooperation management techniques accustomed to management towards the weeds of chilli. This study had been performed in a randomized block that is complete (RCBD) with six (06) treatments. Each treatment was replicated four (04) times. The details of all the treatments were furnished as follows: T_1 = Hand weeding, T_2 = Mulching, T_3 = Hand weeding + Mulching, T_4 = Herbicide, T_5 = Weed free check and T_6 = Unweeded control. The unit plot size was (5m x 5m) = 25m^2. Fertilizer application and intercultural operations were applied as suggested by FRG (2012) as per the recommendation for chilli. Planting materials of chilli were collected from the BARI regional station at Hathazari, Chattogram. A small seed bed measuring 5m x 1m was ready among the nursey in the bed at farmer's field of the study area. Seedling thirty (30) days old were planted within the plots with maintaining recommended spacing.

Data collecting parameters

Dry weight of weeds (g/m^2)

Weed dry weights were recorded at regular intervals in other words, i.e., 30, 60, 90 and at harvest time for every single treatment. The weeds were uprooted from a randomly selected area of 1m^2 and dried at a weight that is constant at 65°C, and the dry weight associated with the weeds were recorded. The weeds' dry weight is expressed in g per 1m^2.

Weed control efficiency (%)

Weed control efficiency could be the ate of weed reduction by weed control treatment (Mani et al., 1973). It's expressed being as a percentage.

$$WCE\ (\%) = \frac{Dry\ weight\ of\ weeds\ in\ unweeded\ control - Dry\ weight\ of\ treatment\ plot}{Dry\ weight\ of\ weeds\ in\ unweeded\ control} \times 100$$

Weed index (%)

The weed index may be the level of yield loss as a result of presence of weeds compared to a weed free check treatment. The weed index could be the percentage of crop loss because of the presence of weeds in the field (Gill & Vijayakumar, 1969). The formulae were used to calculate the weed index.

$$Weed\ index\ (\%) = \frac{x - y}{x} \times 100$$

Where is (x) the total yield from the weed free check treatment and where is (x) the total yield from the treatment for which the weed index has to be calculated.

Plant height (cm)

Through, the root of the plant to the terminal point of growth of the main stem was calculated at 30, 60, 90 DAT and at harvest. The plant that is height is typically expressed in cm.

Number of fruits per plant

The number of fruits per plant had been calculated, the average was calculated and the total number of fruits was counted.

Fruit length (cm)

Fruit lengths collected from five tagged plants, tagged seven times from each experimental plot, were added and an average was calculated and recorded in cm of fruit length per plant. The fruit is measured in centimeters.

Fruit weight (g /fruit)

Five numbers of fruits have been weighed and resolved for a good fresh fruit that is weight and expressed in grams.

Fruit yield (t/ha)

Calculated the fruit yield per hectare, the fresh fruit yield was taken from the net area of the plot.

Statistical analysis and interpretation of data

Field data were interpreted and recorded to produce a table for statistical analysis. The analysis of variance was carried out "R" version 3.2 that is using by De Mendiburu, (2009). Duncan's multiple range tests ended up being used to processing that is separate. Hence, the level of the least significant difference test that is significant having a significance level of 5% had been used to look for the difference between the mean pair (Steel et al., 1997).

RESULTS AND DISCUSSION

Observations on Weed Parameters

The total dry weight of weeds increased significantly in treatment T_6 (460.80 g / m^2), (477.60 g / m^2), (580.40 g / m^2), (632.80 g / m^2) and the lowest dry weight of weeds was observed in T_5 (0.00), followed by T_3 (30.50 g / m^2), (42.30 g / m^2), (54.80 g / m^2) and (68, 40 g / m^2). However, the dry weight of weeds decreased significantly in treatment T_6. The weed index was the lowest in Chilli (3.90%) and therefore the highest weed control efficiency at harvest (89.19%) was in Khagrachari (Table 1). The lowest the weeds' dry weight, the least weeds there are. The lower the dry weight of weeds, the higher the weed control efficiency. The results are in line with the findings reported by Biradar Gandolkar et al. (2015) and Chattopadhyay *et al.,* (2016). The outcomes are in line with those of Ningappa (2013), Shil & Adhikary (2014), and Chaudhari et al. (2017). The results were explained by Rajakumara (2009), Kalasare et al. (2016) The growth parameters were maximized into the test out an address that is a black cover (Choudhary & Bhambri, 2012). Timely eradication of weeds in hand-weeding plots may be a possible reason why is achieving a reduction in weed biomass in these plots (Adhikary et al., 2014). There is certainly less dry weed biomass at the end of the time. Into certain areas addressed with pendimethalin and propaquizafop, weeds were acceptably controlled. Singh et al. (2009) and Rahman et al. (2012) stated that the hand weeding is the weed management technique that is best.

Table 1. Effect of weed management treatments on weed parameters in chilli at Khagrachari

Treatment	Dry weight of weeds (g/m²)				WCE (%)				Weed index (%)
	30 DAT	60 DAT	90 DAT	At harvest	30 DAT	60 DAT	90 DAT	At harvest	
T_1	90.40	105.20	115.50	125.00	80.38	77.97	80.10	80.25	26.97
T_2	82.20	89.50	96.70	106.70	82.16	81.26	83.34	83.14	21.16
T_3	30.50	42.30	54.80	68.40	93.38	91.14	90.56	89.19	3.90
T_4	52.00	65.00	71.00	92.00	88.72	86.39	87.77	85.46	12.70
T_5	0.00	0.00	0.00	0.00	100.00	100.00	100.00	100.00	0.00
T_6	460.80	477.60	580.40	632.80	-	-	-	-	49.05
LSD(0.05)	**13.17**	**11.68**	**12.77**	**16.21**	**1.76**	**3.25**	**3.20**	**2.30**	**8.78**
CV (%)	**4.44**	**4.75**	**5.12**	**4.68**	**5.62**	**4.91**	**5.10**	**4.75**	**4.32**

Data are the average of six observations from 4 replications. In a column, means having same letter(s) are statistically similar at 5% level of significance by LSD.

The total dry weight of weeds had been greated in T_6 (448.80 g/m²), (475.60 g/m²), (567.40 g/m²), (632.80 g/m²) and the lowest dry weight of weeds was observed with weed treatment T_5 (0.00) followed by T_3 (31.50 g/m²), (43.30 g/m²), (49.80 g/m²) and (64.40 g/m²) these data were recorded 30 DAT, 60 DAT, 90 DAT and At harvest, respectively. The lowest weed index in Chilli (4.04%) and thus the highest weed control efficiency at harvest (89.82%) in Rangamati (Table 2). The number of weeds can be a factor in the lower dry weight of weeds. The lower the dry weight of weeds, the higher the weed control efficiency. Comparable results were reported in dry chilli, (Ramakrishna, 2002; Tumbare & Nikam, 2004; Gulshan et al., 2007). The article is entitled Prabhakar et al. (2010) and so it was published by Pandey et al. (2013). In green chilli and Ayodele et al. (2015), there was clearly a person in this report and in Gul et al. (2011) and Shinde et al. (2012), there were demonstrably people in this report.

Table 2. Effect of weed management treatments on weed parameters in chilli at Rangamati

Treatment	Dry weight of weeds (g/m²)				WCE (%)				Weed index (%)
	30 DAT	60 DAT	90 DAT	At harvest	30 DAT	60 DAT	90 DAT	At harvest	
T_1	92.40	96.20	103.50	121.00	79.41	79.77	81.76	80.88	28.02
T_2	79.20	82.50	90.70	105.70	82.35	82.65	84.01	83.30	19.62
T_3	31.50	43.30	49.80	64.40	92.98	90.90	91.22	89.82	4.04
T_4	53.00	58.00	66.00	86.00	88.19	87.80	88.37	86.41	11.70
T_5	0.00	0.00	0.00	0.00	100.00	100.00	100.00	100.00	0.00
T_6	448.80	475.60	567.40	632.80	-	-	-	-	49.05
LSD(0.05)	**13.17**	**11.68**	**12.77**	**16.21**	**2.92**	**2.85**	**2.24**	**2.40**	**7.64**
CV (%)	**4.44**	**4.75**	**5.12**	**4.68**	**5.13**	**4.96**	**5.24**	**5.07**	**4.64**

Data are the average of six observations from 4 replications. In a column, means having the same letter(s) are statistically similar at a 5% level of significance by LSD.

The total dry fat of weeds has been notably greater in T^6 (450.80 g/m²), (472.60 g/m²), (573.40 g/m²), (625.80 g/m²) along with the lowest dry weight of weeds being observed with weed treatment T_5 (0.00) followed by T_3 (32.50 g/m²), (44.30 g/m²), (50.80 g/m²) and (62.40 g/m²) this provided information was in fact recorded 30 DAT, 60 DAT, 90 DAT and at harvest, respectively. The lowest weed index in Chilli (2.68) and thus the highest weed control efficiency at harvest (90.02%) in Bandarban (Table 3). The total number of weeds might be the great reason behind the lower dry weight of weeds. The lower the weed dry weight, the higher the weed control efficiency. The difference in the relationship between

crop yield and dry weed biomass are caused by alterations in crop yield potential and dry weed biomass accumulation, as argued by Clewis et al. (2001). The life cycle of chilli peppers from transplanting to ripening is 26 weeks, requiring up to 12 weeks of weed-free treatment to avoid a loss of more than 5% (Amador Ramírez, 2002). The outcomes act like those of Adhikary & Ghosh (2014). Kumar et al., (2013), also stated that the highest amount of weeds/m^2 on weed control plots and therefore the least easily available on hand weeding.

Table 3. Effect of weed management treatments on weed parameters in chilli at Bandarban

Treatment	Dry weight of weeds (g/m^2)				WCE (%)				Weed index
	30 DAT	60 DAT	90 DAT	At harvest	30 DAT	60 DAT	90 DAT	At harvest	(%)
T_1	93.40	97.20	105.50	119.00	79.28	79.43	81.60	80.98	27.42
T_2	80.20	85.50	92.70	102.70	80.21	81.91	83.83	83.59	20.18
T_3	32.50	44.30	50.80	62.40	92.79	90.63	91.14	90.02	2.68
T_4	55.00	60.00	68.00	88.00	87.80	87.30	88.15	85.94	12.53
T_5	0.00	0.00	0.00	0.00	100.0	100.0	100.0	100.0	0.00
T_6	450.80	472.60	573.40	625.80	-	-	-	-	48.08
LSD(0.05)	**13.17**	**11.68**	**12.77**	**16.21**	**0.92**	**2.45**	**2.20**	**2.34**	**7.22**
CV (%)	**4.44**	**4.75**	**5.12**	**4.68**	**5.16**	**4.88**	**5.47**	**5.18**	**4.75**

Data are the average of six observations from 4 replications. In a column, means having same letter(s) are statistically similar at 5% level of significance by LSD.

Weed that is treatments being various actually different yields and yield components. The perusal of the result indicated that the weed-free check (T_5) recorded significantly the highest number of fruits (132.3 in Khagrachari, 129.90 in Rangamati and 137.60 in Bandarban, respectively), fruit length (7.30 cm in Khagrachari, 7.10 cm in Rangamati and 7.20 cm in Bandarban, respectively), fruit weight (2.10g in Khagrachari, 2.20g in Rangamati and 2.30g in Bandarban, respectively) and yield (12.05 t/ha in Khagrachari, 12.13 t/ha in Rangamati and 12.29 t/ha in Bandarban, respectively). This is in agreement with Imoloame and Muinat (2018) and Daramola et al. (2020), who observed that pre-emergence herbicides gave initial control of weed seedlings but lost efficacy thereafter, thus allowing weed resurgence. The treatment produced the number that is highest of fruits per plant when compared with unweeded control treatment which indicated the best influence on fruit setting in Chilli. The number that is the highest of fruits per plant is in Bandarban followed closely by Khagrachari and Rangamati, respectively. The highest fruit length (7.20 cm in Khagrachari, 7.00 cm in Rangamati and 7.10 cm in Bandarban, respectively) and fruit weight (2.00g in Khagrachari, 2.10g in Rangamati and 2.20g in Bandarban, respectively) were recorded in treatment (T_3) (Table 4). The results were in accordance with Narayan *et al* (2017) who reported recorded highest number of fruits with maximum fruit weight and total fruit yield in case of black plastic mulch (double coated) in chilli. Kumara et al. (2016) stated that the highest green pepper yield can be found in the use of black polyethylene mulch. When the green chilli yield (12.50 t/ha) was low, the yield increased by 38%. These improved monitory returns were attributed to higher green chilli yield as a consequence of effective weed management methods. Similar results are obtained by Gare et al., (2015).

These results are in keeping with the total results of (Frost & Hingston, 2004; Sajjan 2000; Prabhakar et al., 2010; Ramachandrappa et al., 2010) in green chilli. Manohar (2002) stated in pepper and (Krishnamoorthy & Noorjehan, 2014; Leela Rani et al., 2015) in chilli. Similar results had been also acquired by Uddin et al. (2020), hand weeding + mulching gave the corn yield (9.29 t/ha) which is the highest.

Table 4. Effect of weed management treatments on growth and yield parameters in chilli at Khagrachari, Rangamati and Bandarban hill districts

Treatment	Khagrachari				Rangamati				Bandarban			
	No. of fruits/ plant	Fruit length (cm)	Fruit wt. (g)	Yield (t/ha)	No. of fruits/ plant	Fruit length (cm)	Fruit wt. (g)	Yield (t/ha)	No. of fruits/ plant	Fruit length (cm)	Fruit wt. (g)	Yield (t/ha)
T_1	93.60	5.90	1.50	8.80	90.30	6.00	1.40	8.73	89.50	5.80	1.50	8.92
T_2	98.70	6.00	1.60	9.50	96.40	6.10	1.50	9.75	101.50	6.00	1.70	9.81
T_3	130.40	7.20	2.00	11.58	126.70	7.00	2.10	11.64	135.40	7.10	2.20	11.96
T_4	112.50	6.50	1.90	10.52	105.20	6.6	1.80	10.71	117.20	6.40	1.90	10.75
T_5	132.30	7.30	2.10	12.05	129.90	7.10	2.20	12.13	137.60	7.20	2.30	12.29
T_6	52.90	4.80	0.70	6.07	58.90	4.50	0.64	6.18	54.70	4.70	0.60	6.38
LSD (0.05)	**3.11**	**0.25**	**1.01**	**0.44**	**4.38**	**0.75**	**1.21**	**0.76**	**3.30**	**1.02**	**1.07**	**1.72**
CV (%)	**4.34**	**1.49**	**1.25**	**2.47**	**3.21**	**1.54**	**1.09**	**1.77**	**2.20**	**1.64**	**1.18**	**2.31**

Data are the average of six observations from 4 replications. In a column, means having same letter(s) are statistically similar at 5% level of significance by LSD

The weed control effectiveness, how many fruits per plant, fruit length, fruit weight, and fruit yield will be the highest for hand weeding and mulching treatment as compared to other treatments through the above link between the study, it could be concluded that of chilli in the Chattogram Hill Districts. Hand weeding and mulching treatment seem to be guaranteeing for effective, timely, eco-friendly, economical weed control and in addition, provide better soil water conservation in the drought conditions in the hills. The cultivation utilizing this method may result in a wide variety of spices being produced. Further field trials in different agroecological regions would be useful for more precise results.

CONCLUSION

The weed control effectiveness, how many fruits per plant, fruit length, fruit weight, and fruit yield will be the highest for hand weeding and mulching treatment as compared to other treatments through the above link between the study, it could be concluded that of chilli in the Chattogram Hill Districts. Hand weeding and mulching treatment seem to be guaranteeing for effective, timely, eco-friendly, economical weed control and in addition, provide better soil water conservation in the drought conditions in the hills. The cultivation utilizing this method may result in a wide variety of spices being produced. Further field trials in different agroecological regions would be useful for more precise results.

ACKNOWLEDGEMENT

The authors are very thankful to the Krishi Gobeshona Foundation (KGF) for providing the fund to do this research work smoothly with the thematic research project scheme.

AUTHOR CONTRIBUTIONS

Md. Omar Faruq, Md. Riaj Uddin and Md. Rashidul Alam designed the scheme and the final plan for the pilot study and contributed to the manuscript. Md. Omar Faruq participated in the design of the experiment, performed fieldwork, analyzed the results, wrote drafts, and finalized the research article.

COMPETING INTERESTS

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

ETHICS APPROVAL

Not applicable

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