Original Research Article

Effect of integrated weed management practices on growth and yield of green Chilli (*Capsicum annum* L.)

ABSTRACT

A field experiment was conducted at the research farm of Abhilashi University, Mandi (H.P) during the *Kharif* season of 2022. The main objective was to assess the impact of various integrated weed management strategies on the growth and yield of green chilli crops. The experiment consisted of seven treatments with control, laid out in Randomized Block Design with three replications. The treatment details *viz.*, T_1[Weedy check (Control)], T_2(Weed free), T_3[Hand weeding respectively after 30, and 60 days after transplanting (DAT)], T_4[organic mulch (paddy straw)], T_5 (Oxyfluorfen 1.0 kg/ha, T_6 Pendimethalin 1.0 kg/ha) and T_7 (Pendimethalin 1.0 kg/ha. + HW after 60 DAT). The results of the study revealed that the "Weed-free" treatment (T_4) exhibited the highest plant height (80.35 cm), number of leaves per plant (120), number of fruits per plant (85) with an average weight of fruits per plant (276.74 g), dry weight of fruits per plant (33.21 g) and yield (7.56 kg/plot and 189.05 q/ha). The treatment "Pendimethalin 1.0 kg/ha + Hand weeding after 60 DAT" (T_7) followed closely, recording the plant height (75.78 cm), number of leaves per plant (114.66), number of fruits per plant (82.33) with an average weight of fruits per plant (251.56 g), dry weight of fruits per plant (32.7 g) and yield (7.12 kg/plot and 178.08 q/ha). The "Weedy check" treatment (T_1) required the longest duration for 50% flowering and the first and final harvest, with 76, 108 and 124 days, respectively. On the other hand, the "Weed-free" treatment (T_2) required the shortest period, with 66, 93, and 106 days, respectively. Regarding weed-related parameters, the "Weedy check" treatment (T_1) demonstrated the highest weed count (110), fresh weight of weeds (2160.03 g) and dry weight of weeds (388.81 g), while the "Weed-free" treatment (T_2) exhibited the minimum weed count (0.00), fresh weight of weeds (0.00 g) and dry weight of weeds (0.00 g). The highest weed control efficiency (WCE) of 100% and the lowest weed index (0.00%) were observed in the "Weed-free" treatment (T_2), whereas the lowest WCE (0.00%) and the highest weed index (69.69%) were recorded in the "Weedy check" treatment (T1). Economically, the combined treatment of "Pendimethalin 1.0 kg/ha with hand weeding after 60 DAT" (T_7) resulted in the highest net return of 4,39,192.78 ₹ /ha, followed by the "Weed-free" treatment (T_2) with 4,35,207 ₹ /ha. The lowest net return was observed in the "Weedy check" treatment (T_1) with 62,117.28 ₹ /ha.

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Key Words: *Chilli* (*Capsicum annum* L.), *Integrated weed management, Growth, Yield, Weed control*

1. INTRODUCTION

Chilli pepper *(Capsicum annum* L.) holds significant importance as a spice and cash crop in India and various other countries worldwide. With its roots in Mexico and Peru, it is primarily cultivated in tropical and subtropical regions. The fruits of chilli pepper are renowned for their rich nutrient content, containing approximately 292 IU of vitamin A and 111mg of ascorbic acid per 100g of edible matter (Narayan et al. 2017). In India, green chilli is cultivated across an extensive area of 427 thousand hectares, yielding an annual production of 4700 thousand metric tons. Major chilli-producing states include Madhya Pradesh, Karnataka, and Bihar, with Madhya Pradesh leading the production with an area of 57.93 thousand hectares and an output of 906.08 thousand metric tonnes (Anonymous 2022).

Despite its economic significance, the chilli crop faces severe challenges due to weed infestations. Weeds, such as *Cynodon dactylon* (Bermuda grass), *Cyperus rotundus* (coco-grass), *Convolvulus arvensis* (bindweed), *Bidens pilosa* (Blackjack) and *Nicandra physalodes* (apple of Peru) (Handiseni et al. 2008), compete with chilli plants for vital resources, resulting in considerable yield losses. Traditional methods of manual weeding are labour-intensive and time-consuming, making them less practical, particularly during the monsoon season when field conditions become damp and unsuitable for hoeing.

To address this challenge, herbicides have been increasingly utilized to control weeds efficiently. However, some weeds may still escape herbicidal treatment, necessitating the integration of multiple weed management techniques for effective control. Integrated weed management has emerged as a viable solution, combining the use of herbicides with mechanical weed control strategies. Integrated weed management (IWM) is a holistic approach that integrates various strategies to efficiently control and manage weeds in agricultural settings. The central objective of integrated weed management is to reduce weed infestations and their adverse effects on crop development and productivity, all while promoting sustainable resource utilization and minimizing harm to the environment. This research focuses on evaluating the effectiveness of integrated weed management techniques to reduce crop-weed competition during the critical growth stages of chilli plants. By assessing the impact of timely and efficient weed management practices, the aim is to provide insights into achieving sustained agricultural output and enhanced chilli yield.

2. MATERIALS AND METHODS

The research was conducted to evaluate the effect of Integrated Weed Management (IWM) practices on the growth and yield of green chilli (*Capsicum annum* L.). The experiment was laid out in a Randomized Block Design (RBD) with three replications. Seven treatments, including a control, were evaluated to assess their impact on the chilli crop. The chilli variety *Bio Seed 6157* was used in the experiment. Seeds were sown in well-prepared nursery beds measuring 3 m in length, 2 m in width, and 0.15 m in height. The soil was enriched with a mixture of well-rotted farmyard manure (FYM), urea, single super phosphate (SSP) and muriate of potash (MOP). Thiram @ 3g/kg of seeds was applied to treat the seeds before sowing. Regular watering was provided during the germination and growth period. At the time of transplanting the experimental field was harrowed twice and ploughed once with a tractor to attain a fine tilth. Soil pulverization was done using a power tiller, followed by planking. Raised beds of dimensions 2 m × 2 m × 0.1 m were prepared. Nitrogen (N), phosphorus (P_2O_5), and potassium (K_2O) were added to the soil using urea, single super phosphate and muriate of potash, respectively. Full doses of P_2O_5 (60 kg/ha) and K_2O (60 kg/ha) were given at the time of transplanting. Half doses of N (75 kg/ha) was applied at the time of field preparation and the remaining half

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dose was given after six weeks of transplanting in the form of urea as a top dressing. Herbicides, Pendimethalin, and Oxyfluorfen were used as pre-emergence and sprayed three days after transplanting. Hand weeding was performed 30 and 60 days after transplantation. Mulching with paddy straw was done to suppress weed growth. Intercultivation was carried out at 30 and 60 days of transplantation. Irrigation was also provided at regular intervals depending on weather conditions. Various growth and yield metrics were recorded from five randomly chosen plants in each plot. The observations included plant height, number of fruits per plant, number of leaves per plant, fresh and dry fruit weight, yield per plot and yield per hectare. For the dry weight parameter, the fruit and the weeds were kept in the hot air oven for 3 days at 75 ^{0}C for maintaining a consistent weight. Weed control efficiency (WCE) was estimated by the formula given by Mani et al. (1973), and the result was reported in percentage form. Whereas the weed index (WI) was determined using the formula specified by Gill and Vijayakumar (1969), and the result was also reported in percentage form. The data obtained for various parameters were subjected to statistical analysis using the standard procedure of analysis of variance (ANOVA).

3. RESULTS AND DISCUSSION

3.1 Soil studies

In this study, the soil characteristics of the experimental field were determined to establish the initial status of the soil. To achieve this, Auger sampling was employed, randomly collecting samples from different sections of the field at a depth of 0-15 cm. An active soil sample was then made from the composite and subjected to chemical analysis. The results from the soil testing laboratory indicated several key findings. Firstly, the soil displayed a slightly acidic reaction. Secondly, the available nitrogen content was found to be low. Lastly, the soil exhibited a medium level of available phosphorus and potassium content. Table 1 contains the results of the soil testing laboratory analysis.

3.2 Crop studies

Different parameters at the time of harvest per plant were counted and a difference among different treatments has been recorded. The data recorded for the growth parameter is displayed in Table 2. and data for the yield parameter is displayed in Table 3.

(i) Plant height

The experiment conducted on different treatments revealed varying effects on plant height. The highest plant height (80.35 cm) was observed under treatment T_2 (weed free) followed by T_7 (pendimethalin 1.0 kg/ha. + HW after 60 DAT). The minimum plant height (51.00 cm) was found under treatment T_1 (weedy check). The presence of weeds in treatment T_1 (weedy check) likely had a negative impact on plant growth for several reasons. Weeds compete with crops for essential resources such as nutrients, water and sunlight. As a result, they deprived the cultivated plants of these vital elements, leaded to stunted growth and reduced overall height. Due to high competition with weeds, the shortest plant height was obtained in the weedy check. Similar results were also reported by Gasti and Chakravorty (2019), Sathiyamurthy et al. (2017) and Singh et al. (1992).

(ii) Number of leaves per plant

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The highest number of leaves per plant (120.00) were recorded under treatment T_2 (weed free) which was followed by treatment T_7 (pendimethalin 1 kg a.i./ha. + one hand weeding at 60 DAT). The lowest number of leaves per plant (73.67) was noted in treatment T_1 (weedy check). The increased number of leaves per plant in both weed-free and herbicide-treated plots can be attributed to the plant's ability to efficiently utilize the available space, moisture and light, promoted vigorous growth. Whereas the weedy check plots faced intense competition with weeds for essential resources like moisture, nutrients, space and light. As a result, the crop's growth was severely impacted, and the number of leaves per plant was limited in comparison to the weed-free treatment. Similar results were obtained by Gasti and Chakravorty (2019).

(iii) Days required for 50 per cent flowering

Results showed that treatment T_2 (weed free) reported minimum days (66.66) for 50 per cent flowering followed by T_7 (pendimethalin 1.0 kg/ha. + HW after 60 DAT). Maximum days (76.00) were noticed for 50 per cent flowering in T_1 (weedy check). The early flowering in chilli plants under weed-free conditions can be attributed due to the lack of competition for essential resources**.** In weed-free conditions, chilli plants have unrestricted access to these vital resources, enabling them to grow and develop more efficiently. As a result, they reach the flowering stage earlier than when competing with weeds. On the other hand, in weedy check conditions, the presence of weeds creates intense competition for resources. Weeds have rapid and aggressive growth, due to which they uptake significantly more amount of available resources. This competition adversely affected the growth and development of the chilli plants, leaded to delays in their flowering stage. Similar results were also recorded by Kumari et al. (2017).

(iv) Days required for the first and final harvest

Results showed that treatment T_2 (weed free) reported minimum days (93.66 and 106.66) for the first and final harvest respectively, followed by T_7 (pendimethalin 1.0 kg/ha. + HW after 60 DAT). Maximum days (108.00 and 124.00) were noticed under treatment T_1 (weedy check). In weed-free conditions, chilli plants experienced earlier first and final harvests due to better access to essential resources which led to efficient growth and development. Conversely, weedy check conditions with competing weeds delay chilli plant maturity and subsequent harvests, as weeds deprive the plants of crucial resources and hinder their growth. The absence of weeds allows chilli plants to thrive and mature faster, resulted in earlier harvests, while the presence of weeds delays maturity and leads to delayed first and final harvests. Similar results were also recorded by Kumari et al. (2017).

(v) Average weight of fruits per plant (g)

Results showed that treatment T_2 (weed free) reported a maximum average weight of fruits per plant (276.74 g), followed by T_7 (pendimethalin 1.0 kg/ha. + HW after 60 DAT). The minimum average weight of fruits per plant (105.32 g) was noticed under treatment T_1 (weedy check). In the weed-free treatment, chilli fruit achieves maximum weight due to no competition from weeds for essential resources like nutrients, water and sunlight. On the contrary, in the weedy check condition, where weeds grow unchecked alongside chilli plants, the fruit's weight is at its lowest due to intense resource competition

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and hindered growth. Similar findings were reported by Singh et al. (1992), Ningappa (2014), Narasalagi (1999), Khokhar et al. (2007) and Singh et al. (2011).

(vi) Dry weight of fruits per plant (g)

Results showed that treatment T_2 (weed free) reported a maximum dry weight of fruits per plant (33.21 g), followed by T_7 (pendimethalin 1.0 kg/ha. + HW after 60 DAT). The minimum average weight of fruits per plant (9.84 g) was noticed under treatment T_1 (weedy check). The increased dry weight of chilli in weed-free conditions is attributed to the absence of weed competition. In such conditions, chilli plants have improved access to essential resources like nutrients, water and sunlight, promoting their growth and biomass accumulation. On the other hand, weedy check conditions experience intense competition for resources, resulted in reduced growth and lower dry weight of chilli plants. Similar findings were observed by Singh et al. (1992), Hajebi et al. (2015), Ningappa (2014), Narasalagi (2001), Khokhar et al. (2007) and Singh et al. (2011).

(vii) Yield per plot (kg)

Results showed that treatment T_2 (weed free) reported a maximum (7.56 kg) yield per plot, followed by T_7 (pendimethalin 1.0 kg/ha. + HW after 60 DAT). The minimum yield per plot (1.93 kg) was found under treatment T_1 (weedy check). In weed-free conditions, chilli plants achieve maximum yield as they face no competition from weeds, enabling them to access essential resources like nutrients, water and sunlight, leaded to thriving growth and abundant fruit production. On the other hand, weedy check conditions with coexisting weeds create intense resource competition for chilli plants, causing hindered growth and reduced fruit production, resulting in the lowest yield. Similar results were also obtained by Singh et al. (2011), Gare et al. (2015), Cheena et al. (2017), Adigun et al. (2018), Krishnamurthy et al. (2020) and Faruq et al. (2022).

(viii) Yield per hectare (q)

Results showed that treatment T_2 (weed free) reported a maximum (189.05 q) yield per hectare, followed by T_7 (pendimethalin 1.0 kg/ha. + HW after 60 DAT). The minimum yield per plot (48.44 q) was found under treatment T_1 (weedy check). Weed-free conditions lead to maximum chilli yield, as the absence of weed competition allows chilli plants to access vital resources (nutrients, water and sunlight) for thriving growth and abundant fruit production. Conversely, in weedy check conditions, intense resource competition from weeds hinders chilli plant growth, resulted in the lowest yield per hectare. Similar findings were also obtained by Singh et al. (2011), Gare et al. (2015), Cheena et al. (2017), Adigun et al. (2018), Krishnamurthy et al. (2020) and Faruq et al. (2022).

3.3 Weed studies.

The data recorded for the weed studies is displayed in Table 4.

(i) Weed flora

Amaranthus viridis L., *Trianthema portulacastrum* L., *Phyllanthus niruri* L., *Dactyloctenium aegyptium* L., *Cyperus rotundus* L., *Digtaria sanguinalis* L., *Parthenium hysterophorus* L., *Convolvulus arvensis* L., *Portulaca oleracea* L., *Daclyloclenium*

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ilegyptium L., *Lactuca rancinata* Dc., *Celosia argentea* L., *Dinebra retroflexa*, *Physailis minima* L. and *Amaranthus retroflexus* L. were the most common weed species that were found in the experimental field. Similar weeds have also been reported by Robinson et al. (2008), Khokhar et al. (2007), Shaikh (2005), Yadav (2001), Ved Prakash et al. (1999), Narasalagi (1999) and Biradar (1999).

(ii) Weed count per square meter

The results showed that the maximum weeds (110.00) were found in treatment T_1 (weedy check), followed by T_4 [organic mulch (paddy straw)]. The lowest weed density was found under treatment T_2 (weed free). In the weedy check condition, the weed count was high because there were no weeds grown alongside the chilli plants, leading to increased weed density. On the other hand, in the weed-free condition, the weed count was lowest because weeds were eliminated from the field completely. Similar results were also reported by Khokhar et al. (2007), Singh et al. (2011) and Shil and Adhikary (2014).

(iii) Fresh weight and dry weight of weeds (g)

The results showed that the highest fresh and dry weight of weeds (2160.03 g and 388.81 g) were found in treatment T_1 (weedy check), followed by T_4 [organic mulch (paddy straw)]. The lowest fresh and dry weed weight was found under treatment T_2 (weed free). The fresh weight and dry weight of weeds was highest in the weedy check condition because the weeds were allowed to grow unchecked alongside the chilli plants, resulted in vigorous weed growth. In the absence of weed control measures, the weeds had access to ample resources like nutrients, water, and sunlight, enabling them to thrive and accumulate more biomass. On the other hand, in weed-free conditions, the fresh and dry weight of weeds was lowest because efforts were made to control or eliminate weeds. The absence of weed competition and management practices limited the growth and development of weeds, leading to reduced fresh weight and dry weight compared to the weedy check condition. Similar observations were also reported by Narasalagi (2001), Khokhar et al. (2007), Rajkumar (2009), Singh et al. (2011), Ningappa (2014) and Kalasare et al. (2016).

(iv) Weed control efficiency (%)

The results showed that the maximum weed control efficiency (100%) was found in treatment T_2 (weed-free) followed by T_7 (pendimethalin 1.0 kg/ha. + HW after 60 DAT). The minimum weed control efficiency was found under treatment T_1 (weedy check). In the weed-free condition, there were no weeds which led to maximum weed control efficiency as weed growth is completely prevented. This allows chilli plants to access resources and thrive without competition and results in optimal growth and yield. In contrast, in the weedy check condition, weed control efficiency is the lowest as weeds were allowed to grow freely alongside chilli plants. Lack of weed management led to reduced efficiency and negative effects on chilli plant productivity. Similar results were also reported by Faruq et al. (2022), Aviles-Baeza et al. (2022) and Krishnamurthy et al. (2020).

(v) Weed Index (%)

The results showed that the maximum weed index (69.69) was found in treatment T_1 (weedy check), followed by T_4 [organic mulch (paddy straw)]. The lowest weed index (0.00) was observed under treatment T_2 (weed free). The presence of weeds and their

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density was highest in the weedy check condition, where weed control measures were lacking, while the weed-free condition exhibits the lowest weed index due to successful weed management efforts. Similar results were also reported by Faruq et al. (2022), Tursun et al. (2012), Khokhar et al. (2007) and Amador- Ramirez et al. (2002).

3.4 Economics

The data recorded for economics is presented in Table 5.

(i) Cost of cultivation (₹ /ha)

The treatment T_2 (weed free) had the highest total cost of cultivation (₹ 1,31,962.22) followed by T_3 [hand weeding after 30 and 60 DAT] (₹ 99,462.22). The overall cost of cultivation was lowest (₹ 83,212.22) in treatment T_1 (weedy check).

(ii) Gross return (₹ /ha).

The treatment T_2 (weed free) had the highest gross return (₹ 5,67,169.5) followed by T_7 (pendimethalin 1.0 kg/ha. + HW after 60 DAT) (₹ 5,34,236.00). The overall gross return was lowest in treatment T_1(weedy check) (₹ 83,212.22).

(iii) Net return (₹ /ha).

The treatment T_7 (pendimethalin 1.0 kg/ha. + HW after 60 DAT) had the highest net return (₹ 4,39,192.78) followed by T_2 (weed free) (₹ 4,35,207.28). The overall net return was lowest in treatment T_1(weedy check) (₹ 62,117.28).

4. CONCLUSION

The study concluded that weed-free treatment was the best treatment for enhancing the crop and yield parameters. It was also helpful in controlling the weed count which ultimately resulted in increasing the weed control efficiency. Treatment T_7 (pendimethalin 1.0 kg/ha. + HW after 60 DAT) was efficient in achieving the maximum net return due to less labour cost as compared to T_2 (weed free).

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Table 1: Soil properties of the experimental field.

S. No.	Characters	Values obtained
1	pH	5.84
2	Available Nitrogen (kg/ha)	165.42
3	Available Phosphorus (kg/ha)	12.57
4	Available Potash (kg/ha)	130.85

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Table 2: Growth parameters influenced by different treatments.

Treatments	Plant height (cm)	NO. of leaves per plant	Days for 50% flowering	Days req. for harvesting	
				1st harvest	Final harvest
T_1	51.00	73.66	76.00	108.00	124.00
T_2	80.35	120.00	66.66	93.66	106.66
T_3	68.13	107.00	68.66	98.00	112.00
T_4	51.32	97.33	71.33	102.33	118.00
T_5	66.22	105.33	69.33	99.33	114.00
T_6	63.46	101.33	70.66	101.00	116.00
T_7	75.78	114.66	67.66	95.00	108.33
SE(m) ±	2.88	3.97	1.13	1.11	1.04
CD at 5%	**8.99**	**12.39**	**3.52**	**3.48**	**3.25**

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Table 3: Yield parameters influenced by different treatments.

Treatments	Average weight of fruits per plant (g)	Dry weight of fruits per plant (g)	Number of fruits per plant	Yield per plot (kg)	Yield per hectare (q)
T_1	105.32	9.84	61.00	1.93	48.44
T_2	276.74	33.21	85.00	7.56	189.05
T_3	219.97	26.39	80.00	5.71	142.83
T_4	151.11	18.13	70.33	3.29	82.30
T_5	196.34	23.56	78.00	5.00	125.17
T_6	182.76	21.93	77.00	4.41	110.30
T_7	251.56	32.70	82.33	7.12	178.08
SE(m) ±	9.43	1.09	1.86	0.25	6.23
CD at 5%	29.40	3.40	5.79	0.77	19.43

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Table 4: Weed parameters influenced by different treatments.

Treatments	Weed count (No./m^2) At harvest	Fresh weight of weeds (g/ m^2) At harvest	Dry weight of weeds (g/m^2) At harvest	Weed control efficiency (%)	Weed index (%)
T_1	10.53 (110.00) *	46.47 (2160.03) *	19.73 (388.81) *	0.00	69.69
T_2	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	100.00	0.00
T_3	5.65 (31.33)	25.05 (635.53)	10.66 (114.40)	70.79	20.73
T_4	7.96 (62.66)	35.30 (1249.80)	15.00 (224.96)	42.29	53.52
T_5	6.20 (37.66)	27.39 (753.33)	11.65 (135.60)	64.88	24.83
T_6	6.47 (41.00)	28.55 (817.27)	12.14 (147.11)	62.29	39.87
T_7	5.36 (28.00)	23.56 (557.80)	10.03 (100.40)	74.23	4.15
SE(m) ±	0.26	1.20	0.50	-	-
CD at 5%	0.82	3.75	1.58	-	-

** NOTE: Figures in parenthesis are original values*

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Table 5: Economics influenced by different treatments.

Treatments	Total cost (₹ /ha)	Gross income (₹ /ha)	Net income (₹ /ha)
T_1	83,212.22	1,45,329.5	62,117.28
T_2	1,31,962.22	5,67,169.5	4,35,207.28
T_3	99,462.22	4,28,498	3,29,035.78
T_4	98,087.22	2,46,920.8	1,48,833.53
T_5	99,887.22	3,75,514	2,75,626.78
T_6	86,918.47	3,30,910	2,43,991.53
T_7	95,043.22	5,34,236	4,39,192.78
SE(m) ±	-	-	-
CD at 5%	-	-	-

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REFERENCES

1. Adenubi OO and Sanni KO. 2020. Weed interference and fruit yield of chilli pepper (*Capsicum annuum*) as influenced by plant density. *Open Journal of Plant Science* 5: 30-32.
2. Amador-Ramirez MD, Mojarro-Davila F and Velasquez-Valle R. 2006. Efficacy and economics of weed control for dry chilli pepper. *Serie Horti*: 163.
3. Anonymous. 2022. Department of Agriculture and Farmers Welfare, horticulture statistics https://agricoop.nic.in/en/StatHortEst.
4. Biradar S. 1999. Integrated weed management in chilli under northern transitional tract of Karnataka. M.Sc. (Agri) Thesis.
5. Cheena J, Saidaiah P and Geetha A. 2017. Long Term Effect of Integrated Weed Management on Growth and Yield Attributes in Chilli. *International Journal of Current Microbiology and Applied Sciences* 6: 1504-1508.
6. Faruq MO, Uddin MR and Alam MR. 2022. Effect of weed management practices on chilli yield in Chattogram hill districts of Bangladesh. *Journal of innovative agriculture* 9: 32-43.
7. Gare BN, Raundal PU and Burli AV. 2015. Integrated weed management in chilli under rainfed condition. *Indian Journal of Weed Science* 47: 390-392.
8. Gasti DV and Chakravorty S. 2019. Integrated Weed Management in Chilli + Garlic Intercropping System. *International Journal of Current Microbiology and Applied Sciences* 8: 3100-3110.
9. Gill GS and Vijayakumar. 1969. "Weed index" A new method for reporting weed control trials. *Indian Journal of Agronomy* 16: 96-98.
10. Hajebi A, Das TK, Singh SB, Saha S, Sefidkon F, Lebaschi M H and Hajebi F. 2015. Effect of Tillage and Weed Management Practices on Growth and Oleoresin Yield in Chilli (*Capsicum annuum* L.). *Pesticide Research Journal* 27:122-127.
11. Handiseni M, Sibiya J, Ogunlela V and Koomen I. 2008. Comparative study of the effect of different weed management strategies on disease severity and marketable yield of paprika (*Capsicum annuum* L.) in the smallholder farming sector of Zimbabwe. *Journal of Plant Protection Research* 48.
12. Kalasare, Rajesh, Ramesh, Babu, Baburai Nagesh, Aravinda Kumar, Panpatte, Deepak and Shitap Mayur. 2016. Effect herbicides on weeds in chilli + onion + cotton intercropping system. *BIOINFOLET - A Quarterly Journal of Life Sciences* 13: 6-9.

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13. Khokhar KM, Mehmood T and Shakeel M. 2007. Evaluation of integrated weed management practices for chillies in Pakistan. *Crop Protection 26*: 1135-1139.

14. Krishnamurthy D, Desai BK and Maruthi. 2020. Integrated Weed Management in Chilli (*Capsicum annum* L.). *International Journal of Current Microbiology and Applied Sciences* 9: 2319-7706.

15. Kumari V, Singh J, Sharma D and Mishra S. 2017. Evaluation of chilli genotypes for growth and fruit yield attributing traits under Chhattisgarh plain conditions. *International Journal of Current Microbiology Applied Sciences* 11: 3478-3483.

16. Mani VS, Malla ML, Gautam KC and Bhagwndas.1973. Weed killing chemicals in potato cultivation. *Indian Farm*. VXXII: 17-18.

17. Narasalagi VM. 1999. Evaluation of herbicides for weed control in direct seeded onion + chilli intercropping system under rain fed condition. M Sc Thesis, Univ. of Agric. Sci., Dharwad.

18. Narayan S, Makhdoomi MI, Malik A, Nabi A, Hussain K and Khan FA. 2017. Influence of Plastic and organic mulching on productivity, growth and weed density in chilli (*Capsicum annuum* L.). *Journal of Pharmacognosy and Phytochemistry* 6: 1733-1735.

19. Ningappa RB, Tuppad GB and Madhu G. 2014. Sequential application of pre and post emergence herbicides for weed management in chilli+ onion+ cotton intercropping systems. *Trends Biosci*ence 7: 2818-23.

20. Rajkumar S and Palled YB. 2009. Weed management in Drilled Onion (*Allium cepa* L.) + chilli (*Capsicum annum* L.) + cotton (*Gossypium herbaceum* L.) Relay intercropping in rainfedvertisols. *Indian Journal of Weed Science* 41: 189-194.

21. Robinson DE, McNaughton K and Soltani N. 2008. Weed management in transplanted bell pepper (*Capsicum annuum*) with pretransplant tank mixes of sulfentrazone, S-metolachlor, and dimethenamid-p. *Horticultural Science* 43: 1492-1494.

22. Sathiyamurthy VA, Rajashree V, Shanmugasundaram T and Arumugam T. 2017. Effect of different mulching on weed intensity, yield and economics in chilli (*Capsicum annuum* L.). *International Journal of Current Microbiology and Applied Sciences* 6: 609-617.

23. Shaikh A.R. 2005, Integrated weed management in Rabi chilli. (*Capsicum annuum) Indian Journal of Weed Science* 37: 285-286.

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24. Shil S and Adhikary P. 2014. Weed management in transplanted chilli. *Indian Journal of Weed science* 46: 261-263.

25. Singh NP, Johri AK and Singh AK. 1992. Weed management in bell paper (*capsicum annuum* L.*). Indian Journal of Weed science* 24: 56-59.

26. Singh U, Hiremath SM, Halikatti SI, Shashidhara GB and Patil PL. 2011. Evaluation of herbicides for weed control in rainfed transplanted chilli (*Capsicum annuum* L.). *Karnataka Journal of Agricultural Sciences* 24: 125-128.

27. Tursun1 N, Akinci IE, Uludag A, Pamukoglu Z and Gozcu D. 2012. Critical period for weed control in direct seeded red pepper (*Capsicum annum* L.). *Weed Biology and Management* 12: 109–115.

28. Ved Prakash, Pandey AK, Singh RD and Mani VP. 1999. Integrated weed management in chilli under Mid Hill conditions of North-Western Himalayas. *Indian Journal of Weed Science* 31: 164-164.

29. Yadav RS. 2001. Integrated Weed Management in Transplanted Chilli Under Irrigated Condition of Arid Zone. *Annals of Arid Zone* 40: 53-56.

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