Biological Forum – An International Journal **16(6): 159-163(2024)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Influence of Weed Management Treatments on Yield and Quality of Potato

Yogita[1*], Davinder Singh[2], S.K. Dhankhar[3], Todar Mal[4], R.N. Sheokand[5] and Satyawan Arya[6]

[1] Ph.D. Scholar, Department of Vegetable Science, College of Horticulture, Maharana Pratap Horticultural University Karnal (Haryana), India.

[2]Assistant Scientist, Department of Vegetable Science, College of Agriculture, CCSHAU, Hisar (Haryana), India.

[3]Principal Scientist, Department of Vegetable Science, College of Agriculture, CCSHAU, Hisar (Haryana), India.

[4]Assistant Scientist, Department of Agronomy, College of Agriculture, CCSHAU, Hisar (Haryana), India.

[5]Assistant Professor, Computer Section, College of Basic Science and Humanities, CCSHAU, Hisar (Haryana), India.

[6]Assistant Economic Botanist, Department of Genetics and Plant Breeding, CCSHAU, Hisar (Haryana), India.

(Corresponding author: Yogita)*

(Received: 09 April 2024; Revised: 26 April 2024; Accepted: 18 May 2024; Published: 15 June 2024)

(Published by Research Trend)

ABSTRACT: The present experiment was carried out at Research Farm of the Department of Vegetable Science, CCS Haryana Agricultural University, Hisar during winter (*Rabi*) season of the year 2022-2023 and 2023-2024. The potato variety used for the investigation was - Kufri Bahar, which was grown with thirteen treatment different combinations of weed control in randomized block design and replicated three times. The data revealed that weed free treatment (T_{12}) showed superior values for plant height at 80 DAP, total tuber yield and dry matter content of foliage This treatment was statistically at par with T_{11} and T_6. The dry weight of tubers, starch content, reducing sugar, non-reducing sugar and total sugar content of potato tubers depicted no significant difference among the treatments. It was observed that there was increase in all these parameters in all treatments as compared to weedy check (control).

Keywords: *Solanum tuberosum* L., tubers, weed control, dry matter, sugars.

INTRODUCTION

Potato (*Solanum tuberosum* L.) is one of the most important vegetable crops, contributing to the overall food and nutritional security globally after wheat, maize and rice. It is one of the most important staple foods in the world. There are over 200 wild potato species (Bhullar *et al.,* 2015). It is a tuberous crop that comes from the genus Solanum, which is part of the Solanaceae family. The commonly cultivated potato is an autotetraploid (2n=4x=48) It originated in the high Andes region of South America, where Spanish conquerors transported it to Europe at the end of the 16th century. In the first half of the 17th century, it may have been brought to India by Portuguese or British traders (Pandey *et al.,* 2017).

The total production of 376 million tons of potatoes were produced world-wide in an area of 18.1 million hectares and world average yield was about 21 tonnes per hectare (FAO, 2021). In India, it is grown on an area of 2.21 million hectares having a production of 53.38 million tons (NHB, 2021). In Haryana, total area under potato production is 30,916 hectares having a production of 8,18,907 tonnes (Hortharyana, 2023).

Weeds are a major component among the many variables that limit potato production worldwide. Weeds not only hinder plant growth but also lower ultimate yields and lower tuber quality in potatoes. Effective weed control is essential for producing potatoes with high yields and excellent quality (Hutchinson, 2020).

The existence of weeds in potato fields requires more labour for harvesting and inter-cultivation. Weeds can interfere with irrigation and drainage systems and cause problems for machines during important phases such as harvesting and earthing up. As a result, several methods and herbicides have been developed and used throughout time to deal with the weed problems in potato farming (Lavlesh, 2016). This study aims to compare the effectiveness of chemical and non-chemical weed management techniques in potato, taking these factors into consideration.

Our hypothesis was that application of mulches and different herbicides could reduce weed infestation and promote growth, yield and quality of potato crop. The objective of the current study was to investigate the influence of different herbicides and mulches on quality parameters and yield of potato crop in order to provide economical and feasible weed control methods.

MATERIAL AND METHODS

The study was carried out at Research Farm of the Department of Vegetable Science, CCS Haryana Agricultural University, Hisar during winter (*Rabi*) season of the year 2022-2023 and 2023-2024. The potato variety used for the investigation was - Kufri Bahar. The Experiment was laid out in randomized block design and replicated three times. The weed control treatment combinations were thirteen including weed free and weedy check. The plot size was 3.6 m × 2.4 m and spacing of plant to plant and row to row is 60 cm × 20 cm. The location- Hisar is situated at latitude of 29°10′N, longitude of 75°46′E and height of 215.2 meters above mean sea level and falls in semi-arid and sub-tropical region with dry and hot summer and severe cold in winter.

The pooled data was recorded for plant height at 80 DAP (cm), total tuber yield (q/ha) and quality parameters *viz.*, dry matter content of foliage (%), dry matter content of tubers (%), starch content (%), reducing sugar content in tubers (%), non-reducing sugar content in tubers (%) and total sugar content in tubers (%) have been presented in the tables presented below. The experiment was conducted in factorial randomized block design. The data related to various parameters were statistically analyzed by using Analysis of Variance (ANOVA) Technique of Panse and Sukhatme (1987).

RESULTS AND DISCUSSION

The pooled analysis data for plant height at 80 DAP (cm) and total tuber yield (q/ha) presented in Table 1. The various weed control methods significantly affected plant height at 80 DAP and total tuber yield in both the years. The pooled data showed that plant height ranged from 45.9 to 58.6 cm. The highest plant height of 58.6 cm recorded in treatment T_{12} (Weed free) which was statistically at par with T_6 (57.7 cm), T_7 (56.9 cm) and T_5 (56.2 cm),while the lowest (45.9 cm) was recorded with treatment T_{13} (Weedy check). These results are in accordance with Kumar *et al*. (2013) reported that metribuzin treatment resulted in the most significant growth metrics. Kumar *et al.* (2017) observed in their research experiment that the highest plant heights at various days after planting were achieved in the weed-free treatment, following that in different herbicide treatments. According to Abdallah *et al.* (2021), the herbicide metribuzin and double hoeing significantly improved all measured growth factors.

Table 1: Effect of weed control treatments on plant height at 80 DAP (cm) and total tuber yield (q/ha) of potato.

Treatments		Time of Application	Plant height at 80 DAP	Total yield
T_1	Rice straw (6 t ha^{-1})	PE	54.4	223.3
T_2	Pendimethalin 30% EC (1 kg ha^{-1})	PE	53.1	241.1
T_3	Metribuzin 70% WP (0.525 kg ha^{-1})	PE	54.3	298.5
T_4	Oxyfluorfen 23.5% EC (0.150 kg ha^{-1})	PE	53.6	251.2
T_5	Pendimethalin 30% EC (1 kg ha^{-1}) + Rice straw (6 t ha^{-1})	PE	56.2	265.9
T_6	Metribuzin 70% WP (0.525 kg ha^{-1}) + Rice straw (6 t ha^{-1})	PE	57.7	306.7
T_7	Oxyfluorfen 23.5% EC (0.150 kg ha^{-1}) + Rice straw (6 t ha^{-1})	PE	56.9	277.2
T_8	Metribuzin 70% WP (0.525 kg ha^{-1})	PoE	45.4	187.5
T_9	Pendimethalin 30% EC (1 kg ha^{-1}) *fb* Metribuzin 70% WP (0.525 kg ha^{-1})	PE *fb* PoE	47.6	204.5
T_{10}	Oxyfluorfen 23.5% EC (0.150 kg ha^{-1}) *fb* Metribuzin 70% WP (0.525 kg ha^{-1})	PE *fb* PoE	48.8	219.3
T_{11}	Earthing up	30 DAP	54.4	314.8
T_{12}	Weed free		58.6	326.0
T_{13}	Weedy check		45.9	168.3
CD at 5%			2.5	20.9

*PE- Pre-emergence, PoE- Post-emergence, DAP- Days after planting

The range for total tuber yield varied from 168.3 to 326.0 q/ha. The combined data showed that the maximum total tuber yield (326.0 q/ha) was recorded with treatment T_{12} (Weed free) which was statistically at par with T_{11} (314.8 q/ha) and T_6 (306.7 q/ha). These findings are consistent with those of Kumar *et al*. (2013) reported that metribuzin application led to maximum growth parameters, yield attributes and overall potato yield. Bhuller *et al.* (2015) stated that the weight and yield of potato tubers were notably greater in all treatments compared to the untreated control. According to Yadav *et al.* (2021), the weed-free treatment produced the maximum yield of potato, which was statistically at par with the pre-emergence application of metribuzin.

Table 2: Effect of weed control treatments on dry weight of foliage (%), dry weight of tuber (%) and starch content (%) of potato.

Treatments		Time of Application	Dry weight of foliage	Dry weight of tuber	Starch content
T_1	Rice straw (6 t ha^{-1})	PE	10.9	17.8	14.2
T_2	Pendimethalin 30% EC (1 kg ha^{-1})	PE	10.7	17.9	14.3
T_3	Metribuzin 70% WP (0.525 kg ha^{-1})	PE	11.7	18.9	15.1
T_4	Oxyfluorfen 23.5% EC (0.150 kg ha^{-1})	PE	10.8	18.1	14.5
T_5	Pendimethalin 30% EC (1 kg ha^{-1}) + Rice straw (6 t ha^{-1})	PE	11.0	18.3	14.6
T_6	Metribuzin 70% WP (0.525 kg ha^{-1}) + Rice straw (6 t ha^{-1})	PE	11.9	19.2	15.4
T_7	Oxyfluorfen 23.5% EC (0.150 kg ha^{-1}) + Rice straw (6 t ha^{-1})	PE	11.2	18.7	15.0
T_8	Metribuzin 70% WP (0.525 kg ha^{-1})	PoE	10.0	17.5	14.0
T_9	Pendimethalin 30% EC (1 kg ha^{-1}) *fb* Metribuzin 70% WP (0.525 kg ha^{-1})	PE *fb* PoE	10.1	17.7	14.2
T_{10}	Oxyfluorfen 23.5% EC (0.150 kg ha^{-1}) *fb* Metribuzin 70% WP (0.525 kg ha^{-1})	PE *fb* PoE	10.5	17.7	14.2
T_{11}	Earthing up	30 DAP	12.2	19.0	15.2
T_{12}	Weed free		13.1	19.2	15.4
T_{13}	Weedy check		9.3	15.9	12.7
CD at 5%			1.0	NS	NS

*PE- Pre-emergence, PoE- Post-emergence, DAP- Days after planting

The data recorded for dry weight of foliage (%) has been presented in the Table 2. There was significant increase on the dry weight of foliage (%) for both the years. The pooled data revealed that dry weight of foliage was in the range 9.3 to 13.1 per cent. The maximum dry weight of foliage of 13.1%was recorded in treatment T_{12} (Weed free) which was statistically at par with T_{11} (12.2%). However, the treatment T_{13} (Weedy check) observed to have minimum (9.3%) for dry weight of foliage. Similar findings were obtained by Channappagoudar *et al.* (2007); Mondani *et al.* (2013) ; Sitangshu and Majumdar (2013). The data for dry weight of tubers (%) and starch content (%) of potato tubers have also been displayed in Table 2. The data depicted a no significant difference among the treatments of different weed control treatments on dry weight of tubers and starch content of potato tubers in both the years. The dry weight of tubers and starch content was in the range 15.9 to 19.2 per cent and 12.7 to 15.4 per cent, respectively. Although, there was no significant difference among different weed control treatments but it was observed that there was increase in dry matter and starch content of tubers in all weed control treatments as compared to weedy check (control). These results are in the findings of Sukhpreet and Aggarwal (2014). Channappagouder *et al.* (2008) demonstrated that metribuzin led to an elevation in overall starch levels in potatoes. Arora *et al.* (2009) observed that the highest starch content was detected in prometryne followed by mulching treatments following with significant starch levels and manual weeding resulted in the maximum tuber dry matter content. When compared to uncontrolled treatment, dry matter percentages of potato tubers were noticeably higher. Zarzecka *et al.* (2020) found that the dry matter content of potato tubers was not significantly affected by the type of herbicides used.

The pooled data analysis of reducing sugar content in tubers (%), non-reducing sugar content in tubers (%) and total sugar content in tubers (%) is displayed in Table 3. The results indicated no significant differences in all three *i.e.,* reducing sugar content, non-reducing sugar content and total sugar content in tubers among the various weed control treatments for either year. The combined data showed that reducing sugar content, non-reducing sugar content and total sugar content in tubers range varied from 0.18 to 0.45 per cent, 0.12 to 0.30 per cent and 0.48 to 0.66 per cent, respectively. When compared to the weedy check (control), it was discovered that the reducing sugar content and total sugar content in tubers increased among all weed control treatments, in spite of having no significant variations among various weed control treatments. The rise in total sugars or a specific sugar and dry matter content is inherited, but it is also influenced by several environmental circumstances, as stated by Ezekiel *et al.* (1999). Additionally, as mentioned by Shabba *et al.* (2007), a cultivar's hereditary traits include the kind and quantity of sugars. According to Gugała *et al.* (2018), there was only a little rise in the overall sugar content and no discernible effect of the sprayed herbicides they evaluated on the sugar content. The enzyme that catalyzes sucrose's conversion to glucose and fructose may have been activated, leading to the higher sugar levels that were detected.

Table 3: Effect of weed control treatments on reducing, non-reducing and total sugar content (%) in tubers of potato.

Treatments		Time of Application	Reducing sugar	Non-reducing sugar	Total sugar
T_1	Rice straw (6 t ha^{-1})	PE	0.31	0.26	0.57
T_2	Pendimethalin 30% EC (1 kg ha^{-1})	PE	0.39	0.23	0.62
T_3	Metribuzin 70% WP (0.525 kg ha^{-1})	PE	0.4	0.23	0.63
T_4	Oxyfluorfen 23.5% EC (0.150 kg ha^{-1})	PE	0.35	0.28	0.63
T_5	Pendimethalin 30% EC (1 kg ha^{-1}) + Rice straw (6 t ha^{-1})	PE	0.42	0.17	0.59
T_6	Metribuzin 70% WP (0.525 kg ha^{-1}) + Rice straw (6 t ha^{-1})	PE	0.45	0.21	0.66
T_7	Oxyfluorfen 23.5% EC (0.150 kg ha^{-1}) + Rice straw (6 t ha^{-1})	PE	0.37	0.24	0.61
T_8	Metribuzin 70% WP (0.525 kg ha^{-1})	PoE	0.42	0.19	0.61
T_9	Pendimethalin 30% EC (1 kg ha^{-1}) *fb* Metribuzin 70% WP (0.525 kg ha^{-1})	PE *fb* PoE	0.33	0.30	0.63
T_{10}	Oxyfluorfen 23.5% EC (0.150 kg ha^{-1}) *fb* Metribuzin 70% WP (0.525 kg ha^{-1})	PE *fb* PoE	0.34	0.29	0.63
T_{11}	Earthing up	30 DAP	0.42	0.12	0.54
T_{12}	Weed free		0.35	0.20	0.55
T_{13}	Weedy check		0.18	0.30	0.48
CD at 5%			NS	NS	NS

*PE- Pre-emergence, PoE- Post-emergence, DAP- Days after planting

CONCLUSIONS

The study concluded that T_{12} (Weed free) showed superior values for plant height at 80 DAP, total tuber yield and dry matter content of foliage. This treatment was statistically at par with T_{11} and T_6. The dry weight of tubers, starch content, reducing sugar, non-reducing sugar and total sugar content of potato tubers depicted no significant difference among the treatments. It was observed that there was increase in all these parameters in all treatments as compared to weedy check (control).

Acknowledgements. The authors bestow their sincere obeisance to the Department of Vegetable Science, College of Horticulture, CCS Haryana Agricultural University, Hisar for providing the necessary facilities during the course of experiment.

Conflict of Interest. None.

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How to cite this article: Yogita, Davinder Singh, S.K. Dhankhar, Todar Mal, R.N. Sheokand and Satyawan Arya (2024). Influence of Weed Management Treatments on Yield and Quality of Potato. *Biological Forum – An International Journal, 16*(6): 159-163.