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Influence of weed control treatments on available soil nutrient and plant growth parameters of guava (*Psidium guajava L.*)

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ABSTRACT

This study aimed to evaluate the effects of different weed control methods on soil health and growth parameters in guava cultivation. In this study, 9 years old guava plants of cultivar L-49 at CCSHAU, Hisar were selected during the years 2019-20 and 2020-21. A total of twenty-one treatments were applied on guava trees. Soil and leaf nutrient levels were assessed along with growth parameters including plant height, canopy spread, chlorophyll content anwwd leaf area. Among herbicides, glyphosate (1.26 kg/ha) + carfentrazone (20 g/ha) resulted in the highest levels of N (261.77 and 263.86 kg/ha), Zn (6.79 and 6.80 mg/kg), and Fe (2.26 and 2.28 mg/kg) and glyphosate (1.26 kg/ha) + oxyfluorfen (100 g/ha) led to the maximum levels of P (30.20 and 31.27 kg/ha) and K (298.67 and 299.66 kg/ha) respectively. The maximum leaf area (52.21 cm^2 and 54.56 cm^2) and the greatest increase in plant spread (ranging from 6.12% to 7.15%) were recorded in the treatment with glyphosate (1.26 kg/ha) combined with carfentrazone (20 g/ha). The highest increases in plant height were observed with the application of glyphosate (1.26 kg/ha) combined with carfentrazone (20 g/ha) and glyphosate (1.26 kg/ha) combined with oxyfluorfen (100 g/ha), with percentage increases ranging from 6.91% to 7.05% and 6.90% to 7.07%, respectively. Additionally, manual weeding and mulching also resulted in better growth parameters, including increased plant height and canopy spread.

Introduction

Guava (*Psidium guajava* L.) stands out as a highly nutritious and profitable crop, underscoring the critical need for efficient weed management strategies to ensure optimal growth and high-quality fruit yield. In India, guava cultivation spans across 315 thousand hectares, yielding approximately 4916 thousand metric tonnes of produce (Anonymous, 2021-22). Surpassing damages inflicted by other agricultural pests, weeds account for significant losses in guava cultivation (Abouziena and Haggag, 2016). Weeds can reduce yield by 34 % (Jitender *et al.*, 2021), 35 % (Nibhoria *et al.*, 2021) and 53% (Nibhoria *et al.*, 2022) by competing with crop for water, nutrients and space. Weed roots are known to release allelopathic compounds that hinder the growth and productivity of the main crop while also providing shelter to insect pests and microorganisms (Chatha and Chanana, 2007).

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Weed control and crop establishment should be postponed until the primary flush of weed emergence has subsided, allowing the seedbank in the topsoil to deplete and reducing future weed growth (Bond and Grundy, 2001). Seed germination and weed emergence can be influenced by factors such as soil temperature, daily temperature fluctuations, soil moisture, light exposure, nitrate levels, and the gaseous composition of the soil (Merfield, 2013). Herbicidal approaches are gaining prominence due to their cost-effectiveness in weed management. Herbicides play a crucial role in minimizing weed infestation and maximizing yield (Ashiq *et al.,* 2007). However, the effectiveness of herbicides is contingent upon various factors such as soil type, environmental conditions, herbicide dosage and the susceptibility of non-target species.

Material and Methods

The experiment was conducted at the experimental orchard of Chaudhary Charan Singh Haryana Agricultural University, located in Hisar, during the years 2019 and 2020. A total of twenty-one treatments, each with three replications, were employed using a randomized block design. The experimental location is situated at latitude of 29°10'N, longitude 75°46'E and altitude 215.2 m above mean sea level. The experiment was conducted on nine-year old plants of the L-49 cultivar, planted at 6m x 6 m spacing. The treatments comprised of - T_1 (Glyphosate @ 1.68 kg/ha), T_2 (Carfentrazone @ 20 g/ha), T_3 (Oxyfluorfen @ 150 g/ha), T_4 (Glufosinate @ 500 g/ha), T_5 (Pendimethalin @ 1.5 kg/ha), T_6 (Paraquat @ 0.9%), T_7 (2,4-D @ 1.0 kg/ha), T_8 (Glyphosate @ 1.26 kg/ha + carfentrazone @ 20 g/ha), T_9 Glyphosate (1.26 kg/ha + oxyfluorfen 100 g/ha), T_{10} (Glyphosate @ 1.2 kg/ha + 2,4-D @ 50 g/ha), T_{11} (Glyphosate @ 1.26 kg/ha + pendimethalin @ 1.0 kg/ha), T_{12} (Glyphosate @ 1.26 kg/ha + paraquat @ 0.6%), T_{13} (Glufosinate @ 375 g/ha + pendimethalin @ 1.0 kg/ha), T_{14} (Glufosinate @ 375 g/ha + oxyfluorfen @ 100 g/ha), T_{15} (Glufosinate @ 375 g/ha + paraquat @ 0.6%), T_{16} (Paraquat @ 0.6% + pendimethalin @ 1.0 kg/ha), T_{17} (Mechanical weeding after 30, 60 and 90 Days after application), T_{18} (Mulching with black polythene), T_{19} (Weedy check), T_{20} (Weed free) and T_{21} (Three times hand weedings).

The available nitrogen content in the soil was determined using the Alkaline Permanganate Method proposed by Subbiah and Asija (1956). Phosphorus availability was assessed following the procedure outlined by Olsen *et al.* (1954). The soil's available potassium was measured using neutral normal NH_4OAC solution and a Flame photometer, as described by Hanway and Heidal (1952). Zinc and iron extractable by DTPA were estimated according to the method outlined by Lindsay and Norvell (1978). Leaf area was measured using a Leaf Area Meter. Chlorophyll content was determined using the DMSO method as described by Sawhney and Singh (2002). Plant height was measured in meters using a measuring pole, reaching the maximum point of height. The distance between the points where most branches of the tree had grown in the east-west and north-south directions was measured using a measuring pole as well.

Results and Discussion

Soil nutrients

Different weed control treatments significantly influenced the availability of nitrogen (N), phosphorus (P), potassium (K), zinc (Zn), and iron (Fe). Under weed-free conditions, the availability of N (263.33 and 263.33 kg/ha), P (31.34 and 31.52 kg/ha), K (302.20 and 303.57 kg/ha), Zn (6.83 and 6.83 mg/kg) and Fe (2.30 and 2.31 mg/kg) was the highest during 2019 and 2020, respectively (Table 1). Among herbicidal treatments, glyphosate (1.26 kg/ha) + carfentrazone (20 g/ha) resulted in the highest levels of N (261.77 and 263.86 kg/ha), Zn (6.79 and 6.80 mg/kg), and Fe (2.26 and 2.28 mg/kg). Glyphosate (1.26 kg/ha) + oxyfluorfen (100 g/ha) led to the maximum levels of P (30.20 and 31.27 kg/ha) and K (298.67 and 299.66 kg/ha).

Conversely, the lowest available nutrient levels were observed in the weedy check treatment with N (224.12 and 226.00 kg/ha), P (17.33 and 17.33 kg/ha), K (256.33 and 258.77 kg/ha), Zn (6.51 and 6.53 mg/kg) and Fe (2.08 and 2.10 mg/kg) during both years, respectively. Similarly, Palma *et al.* (2002) noted a positive impact of herbicidal spray on the performance of grape cv. Italia, with vines showing no symptoms of water or nutrient deficiency.

Leaf nutrients

In this investigation, the various weed control methods exhibited non-significant impact on the nutrient's composition of guava leaves. However, the weed-free treatment showed numerically higher levels of nitrogen (N), phosphorus (P), and potassium (K) with concentrations of 1.76% and 1.77%, 0.18% and 0.19%, and 1.39% and 1.41% respectively, across both the years 2019 and 2020. Conversely, the weedy check treatment yielded the lowest N, P, and K levels, measuring 1.58% and 1.61%, 0.16% and 0.18% and 1.16% and 1.18% respectively, during the same period. These findings align with Wright *et al.* (2003) who reported similar results regarding orchard floor vegetation's negligible influence on citrus leaf nutrient concentrations. Conversely, studies on apple orchards by Akanda *et al.* (1997), Cerda *et al.* (1999) and Banaszkiewicz and Kopyutowski (2003) indicated that glyphosate application boosted leaf nutrient content.

Table 1. Effect of different herbicides on available N, P, K, Zn and Fe in soil of guava cv. L-49 orchard

Treatment	N (kg/ha)		P (kg/ha)		K (kg/ha)		Zn (mg/kg)		Fe (mg/kg)	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
T1: Glyphosate (1.68 kg/ha)	256.57	257.67	27.80	28.50	295.56	296.51	6.76	6.77	2.22	2.24
T2: Carfentrazone (20 g/ha)	249.28	251.33	24.21	25.79	290.44	291.74	6.72	6.74	2.21	2.22
T3: Oxyflourfen (150 g/ha)	252.33	254.56	25.33	26.40	291.31	293.55	6.74	6.76	2.22	2.23
T4: Glufosinate (500 g/ha)	232.55	235.21	26.28	27.33	293.67	295.78	6.75	6.76	2.22	2.23
T5: Pendimethalin (1.5 kg/ha)	224.21	226.60	18.22	19.45	274.89	276.67	6.64	6.65	2.14	2.16
T6: Paraquat (0.9%)	231.96	233.67	19.41	20.67	277.67	277.70	6.65	6.66	2.15	2.16
T7: 2,4-D (1.0 kg/ha)	247.93	250.33	24.33	25.33	289.37	290.59	6.72	6.74	2.21	2.22
T8: Glyphosate (1.26 kg/ha) + carfentrazone (20 g/ha)	261.77	263.86	29.22	30.20	297.63	299.51	6.79	6.80	2.26	2.28
T9: Glyphosate (1.26 kg/ha) + oxy-flourfen (100 g/ha)	259.51	260.40	30.20	31.27	298.67	299.66	6.78	6.80	2.20	2.26
T10: Glyphosate (1.26 kg/ha) +2,4-D (750 g/ha)	246.33	248.00	23.45	25.67	286.67	287.61	6.72	6.73	2.20	2.21
T11: Glyphosate (1.26 kg/ha) + pendimethalin (1.0 kg/ha)	257.44	258.33	28.00	29.53	296.56	298.66	6.77	6.79	2.23	2.25
T12: Glyphosate (1.26 kg/ha) + paraquat (0.6%)	242.67	244.29	22.67	24.33	282.67	283.32	6.69	6.70	2.19	2.20
T13: Glufosinate (375 g/ha) + pendi-methalin (1.0 kg/ha)	237.67	239.67	20.00	21.67	276.33	279.34	6.67	6.69	2.16	2.17
T14: Glufosinate (375 g/ha) + oxy-flourfen (100 g/ha)	239.33	240.61	21.67	23.67	281.33	282.59	6.68	6.70	2.18	2.19
T15: Glufosinate (375 g/ha) + para-quat (0.6%)	238.51	238.33	21.33	22.78	280.33	281.62	6.68	6.69	2.17	2.18
T16: Paraquat (0.6%) + pendime-thalin (1.0 kg/ha)	235.67	236.64	19.54	22.33	275.33	278.65	6.66	6.67	2.15	2.17
T17: Mechanical weeding after 30,60,90 days after application	262.33	264.33	30.75	31.50	300.37	302.44	6.80	6.82	2.28	2.30
T18: Mulching with black polythene	258.81	260.33	28.19	29.84	295.33	297.88	6.77	6.79	2.25	2.27
T19: Weedy	224.12	226.00	17.33	17.33	256.33	258.74	6.51	6.53	2.08	2.10
T20: Weed free	266.33	268.33	31.34	31.52	302.20	303.57	6.83	6.83	2.30	2.31
T21: Three times hand weeding	252.45	256.77	27.82	28.67	293.33	295.67	6.76	6.79	2.25	2.26
SEm±	1.78	1.48	1.13	1.70	1.39	1.56	0.02	0.01	0.03	0.01
CV (%)	1.25	1.03	7.92	11.26	0.84	0.93	0.63	0.36	2.26	1.02
CD at 5%	5.11	4.23	3.25	4.84	3.98	4.47	0.07	0.04	0.08	0.04

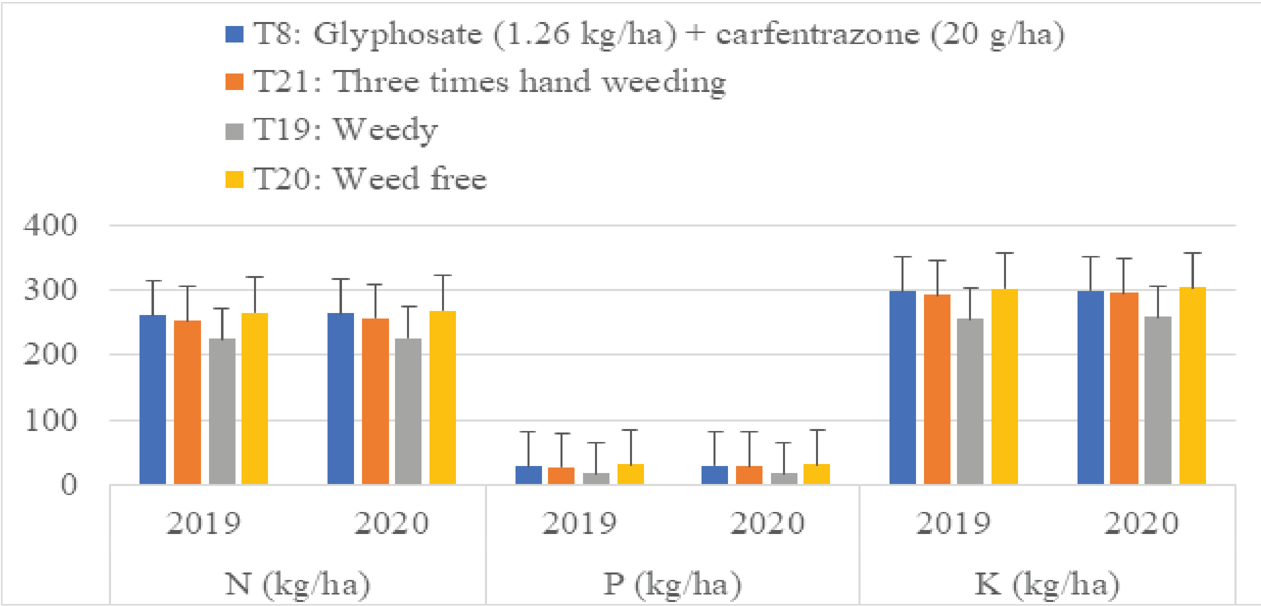

Fig. 1. Effect of different herbicides on available N, P and K in soil of guava cv. L-49 orchard

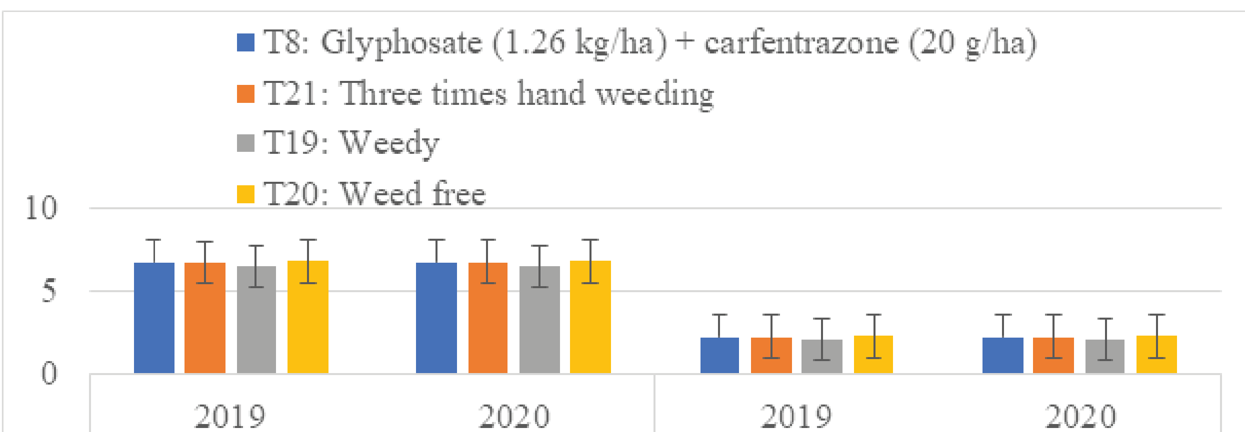

Fig. 2. Effect of different herbicides on available Zn and Fe in soil of guava cv. L-49 orchard

Table 2. Effect of different herbicides and other weed management treatments on per cent increase in growth and chlorophyll in leaves of guava cv. L-49

Treatment	Plant height (%)		Plant spread (%)				% increase in chlorophyll		Leaf area (cm²)	
			EW		NS					
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
T1: Glyphosate (1.68 kg/ha)	6.83	6.98	6.98	7.00	5.66	5.78	14.37	16.96	48.51	50.46
T2: Carfentrazone (20 g/ha)	6.75	6.90	6.81	6.92	5.48	5.59	12.75	12.31	45.22	46.58
T3: Oxyflourfen (150 g/ha)	6.78	6.92	6.88	6.97	5.52	5.60	13.35	13.72	46.51	47.86
T4: Glufosinate (500 g/ha)	6.81	6.94	6.92	7.00	5.57	5.63	13.61	15.09	47.44	49.68
T5: Pendimethalin (1.5 kg/ha)	6.51	6.71	6.43	6.48	5.02	5.08	4.14	2.74	31.40	33.22
T6: Paraquat (0.9%)	6.54	6.72	6.47	6.51	5.08	5.14	4.86	3.77	32.69	34.21
T7: 2,4-D (1.0 kg/ha)	6.73	6.88	6.77	6.89	5.42	5.52	7.55	5.59	43.22	45.35
T8: Glyphosate (1.26 kg/ha) + carfentrazone (20 g/ha)	6.91	7.05	7.07	7.15	6.12	6.20	22.95	22.84	52.21	54.56
T9: Glyphosate (1.26 kg/ha) + oxyflourfen (100 g/ha)	6.90	7.07	7.04	7.11	6.10	6.21	18.85	19.78	52.00	53.21
T10: Glyphosate (1.26 kg/ha) +2,4-D (750 g/ha)	6.70	6.85	6.71	6.82	5.35	5.48	11.01	11.28	41.30	43.55
T11: Glyphosate (1.26 kg/ha) + pendimethalin (1.0 kg/ha)	6.88	7.01	7.00	7.05	5.62	5.74	15.34	17.99	50.33	52.35
T12: Glyphosate (1.26 kg/ha) + paraquat (0.6%)	6.68	6.83	6.67	6.69	5.29	5.36	7.47	7.79	40.54	42.31
T13: Glufosinate (375 g/ha) + pendimethalin (1.0 kg/ha)	6.59	6.75	6.53	6.62	5.14	5.21	11.12	9.46	35.55	36.42
T14: Glufosinate (375 g/ha) + oxyflourfen (100 g/ha)	6.65	6.81	6.58	6.66	5.22	5.31	10.79	10.30	38.98	39.21
T15: Glufosinate (375 g/ha) + paraquat (0.6%)	6.60	6.77	6.54	6.64	5.19	5.26	8.96	9.16	36.42	38.24
T16: Paraquat (0.6%) + pendimethalin (1.0 kg/ha)	6.57	6.74	6.50	6.57	5.11	5.19	7.94	8.62	33.21	35.64
T17: Mechanical weeding after 30,60,90 days after application	6.93	7.09	7.08	7.17	6.16	6.26	24.23	23.96	52.21	54.56
T18: Mulching with black polythene	6.96	7.07	7.05	7.13	6.14	6.22	21.33	22.60	51.25	53.36
T19: Weedy	5.51	5.56	6.31	6.32	5.00	5.02	0.09	0.00	28.21	30.14
T20: Weed free	6.98	7.15	7.12	7.20	6.19	6.30	26.75	25.12	56.21	58.51
T21: Three times hand weeding	6.92	7.04	7.01	7.10	6.10	6.18	20.86	20.90	50.00	52.36
SEm±	0.05	0.04	0.04	0.03	0.04	0.05	0.22	0.26	1.46	1.50
CV (%)	1.26	1.01	0.94	0.87	1.27	1.46	2.26	2.29	5.81	5.72
CD at 5%	0.15	0.12	0.11	0.10	0.12	0.14	0.63	0.74	4.21	4.31

spectively. While it was lowest in weedy check *i.e.* zero percent during both the years. The results are in accordance with the findings of Pathak *et al.* (2007) who observed stimulatory effect of glyphosate and paraquat application on chlorophyll content in guava.

Plant height and plant spread

The percentage increase in plant height was notably highest in the weed-free treatment, reaching 6.98% and 7.15% over the two years (Table 2). Among herbicidal treatments, glyphosate (1.26 kg/ha) + carfentrazone (20 g/ha) and glyphosate (1.26 kg/ha) + oxyflourfen (100 g/ha) both demonstrated significant increases in plant height, with percentages ranging from 6.91and 7.05% and 6.90% to 7.07% during both years respectively. Conversely, the weedy check consistently showed the lowest percentage increase in plant height, ranging from 5.51% to 5.56% across both years.

Regarding plant spread, the weed-free treatment exhibited significantly higher increases in both the east-west (EW) and north-south (NS) directions, ranging from 6.19% to 7.20%. Among herbicides, glyphosate (1.26 kg/ha) + carfentrazone (20 g/ha) also showed notable increases in plant spread, ranging from 6.12% to 7.15%. Conversely, the weedy check displayed the least increase in plant spread, with percentages ranging from 5.00% to 6.32% in EW and NS directions, respectively.

The observed increases in plant height and spread can be attributed to effective weed population reduction, leading to improved nutrient and water availability due to various weed control treatments. These findings are consistent with Pathak *et al.* (2007) who demonstrated that the application of glyphosate before and after sowing increased guava plant height, while post-emergence application reduced it in guava seedlings.

Conclusion

The findings of the investigation highlighted the importance of selecting appropriate weed control methods to enhance soil health and optimize growth parameters in guava cultivation. The maximum soil nutrients, leaf area and growth parameters were found in weed free treatment. Among herbicides, glyphosate (1.26 kg/ha) + carfentrazone (20 g/ha) treatment was found effective for soil nutrient status (N: 261.77 and 263.86 kg/ha; Zn: 6.79 and 6.80 mg/kg, and Fe: 2.26 and 2.28 mg/kg); leaf area (52.21 and 54.56 cm^2) and other parameters in improving the growth of guava.

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References

Abouziena, H.F. and Haggag, W.M. 2016. Weed control in clean agriculture: A review. *Planta Daninha*, 34(2): 377-392.

Anonymous 2020. Second advance estimate. National Horticulture Board, Government of India, Gurgaon, Haryana, India.

Ashiq, M., Sattar, A., Ahmed, N. and Muhammad, N. 2007. Role of herbicides in crop production. Unique enterprises 17-A, Gulberg colony, Faisalabad, Pakistan.

Banaszkiewicz, T. and Kopytowski, J. 2003. Some aspects of glyphosate use in apple orchards. *Sodininkyste ir Darzininkyste*, 22: 41-46.

Bond, W. and Grundy, A. C. 2001. Non-chemical weed management in organic farming systems. *Weed Research,* 41: 383-405.

Cerda, J.J., Mendoza, M., Santiago, J., Nieto, F. and Cortez, S. 1999. Weed chemical control in apple (*Pyrus malus* L.) coadjuvants. *Agronomia Mesoamericana*, 10(1): 7-15.

Chatha, R.P.S. and Chanana, Y.R. 2007. Studies on weed management in young peach orchards. *Indian Journal of Horticulture*, 64: 300-303.

Hanway, J.J. and Heidel, H.H. 1952. Soil analysis methods as used in Iowa State College, Soil Testing Laboratory. Iowa State College Bull., 57: 1-131.

Lindsay, W.L. and Norvell, W.A. 1978. Development of a DTPA soil test for zinc, iron, manganese and copper. *Soil Science Society of America Journal*, 42: 421-28.

Merfield, C. N. 2013. False and stale seedbeds: The most effective non-chemical weed management tools for cropping and pasture establishment. Lincoln: The BHU Future Farming Centre, 23.

Olsen, S.R., Cole, C.V., Watanabe, F.S. and Dean, L.A. 1954. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. United States Department of Agriculture, Washington, 939.

Palma, L., Novello, V., Montemurro, P. and Gisell, A. 2002. Ecological and agronomic response of *Vitis vinifera* L. cv. Italia to different techniques of soil management. *Italus Hortus*, 9(4): 15-22.

Pathak, S.M., Singh, D.K. and Singh, V.K. 2007. Effect of herbicides on growth, weed infestation and physio-biochemical changes in guava (*Psidium guajava* L.) seedling. *Acta Horticulturae,* 735: 315-320.

Sawhney, V. and Singh, D.P. 2002. Effect of chemical desiccation at the post-anthesis stage on some physiological and biochemical changes in the flag leaf of contrasting wheat genotypes. *Field Crops Research*, 77(1): 1-6.

Soni, J.K., Amarjeet, Punia, S.S. and Choudhary, V.K. 2021. Herbicide combinations for management of resistance in *Phalaris minor*. *Indian Journal of Weed Science,* 53(1): 41-48.

Soni, J.K., Nibhoria A., Punia, S.S. and Surbhi, H. 2024. Assessment of herbicide resistance in *Phalaris minor* and managing clodinafop-resistance with alternative herbicides. *Indian Journal of Weed Science,* 56(2): 142-150

Subbiah, B.V. and Asija, G.L. 1956. A rapid procedure for the determination of available nitrogen in soils. *Current Science*, 25: 259-60.

Wright, G.C., McCloskey, W.B. and Taylor, K.C. 2003. Managing orchard floor vegetation in flood- irrigated citrus groves. *HortTechnology*, 13: 668-677.