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Performance of mint (*Mentha arvensis* L.) crop as influenced by different combinations of nutrients and plant growth regulators (PGR) and its management practices in Chhattisgarh plain ecosystem

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Abstract

Mentha is an aromatic perennial herb belongs to family Lamiaceae. Japanese mint (*Mentha arvensis* L.) accounts for more than 80 per cent of total area than other species. It is one of the most extensively cultivated mint species all over the world due to its high menthol content. A field experiment was conducted at Department of Plant Physiology, Agriculture Bio – chemistry, Medicinal and Aromatic Plants, IGKV, Raipur (C.G.) during rabi season of 2021-2022 to study the effect of nutrients, sulphur and plant growth regulators on oil yield of mint (*Mentha arvensis* L.). The randomized block design was used to conduct the experiment with three replications. There were nine treatments *viz*., T_1 (Control), T_2 (NPK @ 90:50:40 kg ha^{-1}), T_3 (NPK @ 110:60:50 kg ha^{-1}), T_4 (T_2 + GA3 @ 140 ppm ha^{-1}), T_5 (T_3 + GA3 @ 200 ppm ha^{-1}), T_6 (T_2 + foliar application of NPK (19:19:19) @ 0.5% with one application), T_7 (T_3 + foliar application of NPK (19:19:19) @ 0.5% with two application), T_8 (T_2 + sulphur @ 15 kg ha-1), T_9 (T_3 + sulphur @ 25 kg ha^{-1}). The variety was CIM-Kranti All the treatments significantly influenced most of the growth and yield components of mint. The plant height, number of leaves per plant, crop growth rate and specific leaf weight were highest with the application of NPK @ 110:60:50 kg ha^{-1} + sulphur @ 25 kg ha^{-1} (T_9). The study also revealed that Japanese mint treated with T_9 (T_3 + sulphur @ 25 kg ha^{-1}) showed maximum herbage yield (158.4 q ha^{-1}), oil yield (116.7 kg ha^{-1}) and net return (86,258 Rs ha^{-1}) which was followed by T_5 (T_3 + GA3 @ 200 ppm ha^{-1}).

Keywords: Sulphur, NPK, Gibberellic acid, Japanese mint, growth, yield

Introduction

Japanese mint (*Mentha arvensis* L.), a succulent and multi-cut annual of Lamiaceae family. At present, Japanese mint is cultivated in India on about 60,000 hectares. of land with estimated production of 12,000 tonnes of mint oil which accounts for about 75% of total menthol mint production in the world (Essential oils association of India 2001, vision 2005). In India, the total area under mint cultivation, which is mostly confined to Uttar Pradesh and the Punjab is around 10,000 ha. India is a leading exporter contributing about 80% (40,000 tons) of essential oil, menthol crystal and allied products. Mint is used for flavouring meat, fish, sauces, soups, stews, vinegar, tea, tobacco and cordials. In medicine, it is used against stomach disorders, rheumatism, in ointments for headaches, in cough drops, inhalations etc. Present investigation is undertaken to study its growth and yield performance in response to nitrogen, phosphorus, potassium, sulphur, foliar application of nutrients and suitable plant growth regulators like gibberellic acid under Chhattisgarh plain ecosystem.

Material and Methods

The field experiment was carried out at university farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during Rabi season 2021-2022. The site where experiment was laid out is classified as vertisols (sandy clay loam soil) also known as Kanhar soil in Chhattisgarh having the pH of 7.38, available nutrients *viz*., N (225.06 kg/ha), P (20.75 kg/ha) and K (366.18 kg/ha). The experiment was laid out in randomized block design with nine treatment combinations *viz*., T_1 (Control), T_2 (NPK @ 90:50:40 kg ha^{-1}), T_3 (NPK @ 110:60:50 kg ha^{-1}), T_4 (T_2 + GA3 @ 140 ppm ha^{-1}), T_5 (T_3 + GA3 @ 200 ppm ha^{-1}), T_6 (T_2 + foliar application of NPK (19:19:19) @0.5% with one application), T7 (T_3 + foliar application of NPK (19:19:19) @ 0.5% with two application), T_8 (T_2 + Sulphur @ 15 kg ha^{-1}),

T_9 (T_3 + sulphur @ 25 kg ha^{-1}) and three replications. Nutrient, GA3 and sulphur were applied to each plot as per the treatment combinations. Nitrogen was given in split doses, one as a basal dose and another after 45 days of planting in the form of urea. Phosphorus was applied as a basal dose in the form of single super phosphate. Potassium as a basal dose in the form of muriate of potash was uniformly applied to each plot. In Some plots GA3, NPK foliar spray and sulphur is applied as per the treatment combinations. The CIM- Kranti variety was used. The fertilizer mixture was applied by broadcasting uniformly in rows to individual plots and mixed thoroughly in to the soil. At different time intervals data were collected on plant height (cm), number of leaves per plant, crop growth rate (g m-2 day^{-1}) and specific leaf weight (g cm-2). The different post harvesting observations such as herbage yield (g ha^{-1}), oil yield (kg ha^{-1}) and net return (Rs ha^{-1}) were taken after final harvesting i.e., at 120 DAP. The oil in the fresh herbage was extracted through steam distillation using Clevenger's apparatus. The collected data were compiled and tabulated as per the treatments.

Result and Discussion

Plant height (cm): The data on plant height progression of mint at different plant growth stages as influenced by various nutrient management practices, gibberellic acid and sulphur were significant (table 1). The different nutrient management practices of gibberellic acid were influenced significantly on plant height at 40 DAP, 80 DAP and at harvest stage of crop. Data on plant height was noted at different time interval, it was revealed that with the advancement of crop age, it also increases significantly at 80DAP and at harvest stage. The maximum plant height was recorded with application of NPK @ 110:60:50 kg ha^{-1} with sulphur @ 25 kg/ha (61.51 cm) followed by NPK @ 110:60:50 kg ha^{-1} with GA3 @ 200 ppm ha^{-1} (54.09 cm) at harvest stage while control (37.73 cm) showed the minimum plant height. The increase in plant height with the application of nutrient, sulphur and gibberellic acid is due to as sulphur acts as a cofactor in some metabolic enzymes and gibberellic acid influences the internodal elongation.

Number of leaves plant^{-1}: The no. of leaves at different plant growth stages were influenced significantly by various nutrient management practices and gibberellic acid (table 1). The number of leaves per plant was collected at different time interval, it was revealed that with the advancement of crop age, it also increases significantly at 80 DAP and at harvest. At harvest maximum no. of leaves (81.22) was recorded by application of NPK @ 110:60:50 kg ha^{-1} with sulphur @ 25 kg ha^{-1} which was followed by NPK @ 110:60:50 kg ha^{-1} with GA3 @ 200 ppm ha^{-1} (69.22). While control recorded the minimum no. of leaves (44.22). The increase in no. of leaves per plant with the application of sulphur and gibberellic acid might be due to as sulphur is necessary for chlorophyll formation, and gibberellic acid stimulates both cell division and elongation.

Crop growth rate (g m-2 day^{-1}): The application of NPK @ 110:60:50 kg ha^{-1} with sulphur @ 25 kg ha^{-1} had significantly influenced on crop growth rate (CGR) at all stages of observation (table 2, fig 1). The crop growth rate of mint was recorded at 0-30 DAP, 30-60 DAP, 60-90 DAP and 90 DAP-harvest stage. This might be due to suitability of temperature, rainfall, soil moisture, solar radiation and mineral nutrients in soil. In mint, maximum crop growth rate was obtained with application of NPK @ 110:60:50 kg ha^{-1} with sulphur @ 25 kg ha^{-1} (0.67) followed by NPK @ 110:60:50 kg ha^{-1} with GA3 @ 200 ppm ha^{-1} (0.64) at 60-90 DAP while control (0.42) showed the minimum.

Specific leaf weight (g cm-2): The data pertaining to specific leaf weight at different plant growth stages were influenced significantly by various nutrient management practices, gibberellic acid and sulphur (table 2). Data on specific leaf weight revealed that with the advancement of crop age, it also increases significantly at 80 DAP but not at 40 DAP of mint. At 80DAP the maximum specific leaf weight (0.55) was recorded by application of NPK @ 110:60:50 kg ha^{-1} with sulphur @ 25 kg ha^{-1} [T_9], followed by NPK @ 110:60:50 kg ha^{-1} with GA3 @ 200 ppm ha^{-1} [T_5] (0.50); while control [T_1] showed the minimum specific leaf weight (0.36).

Herbage yield (q ha^{-1}): Data pertaining to herbage yield per plant of mint were influenced significantly by various nutrient management practices, sulphur and gibberellic acid (table 3). The application of various nutrient management practices and gibberellic acid had significant effect on herbage yield. Maximum herbage yield was obtained with application of NPK @ 110:60:50 kg ha^{-1} with sulphur @ 25 kg ha^{-1} [T_9] (158.4 q ha^{-1}) which was significantly superior over all other treatments and followed by NPK @ 110:60:50 kg ha^{-1} with GA3 @ 200 ppm ha^{-1} [T_5] (154.2 q ha^{-1}). The increase in herbage yield quintal hectare^{-1} with application of sulphur might be due to as sulphur plays an important role in enhancing the carbohydrate and protein synthesis and also due to higher shoot length, number of branches plant^{-1}, number of leaves plant^{-1} and all other optimum growth parameters of crop.

Oil yield (kg ha^{-1}): Data pertaining to oil yield kilogram/hectare of mint were influenced significantly by various nutrient management practices, sulphur and gibberellic acid (table 3). The application of various nutrient management practices and gibberellic acid had significant effect on oil yield of crop. Maximum oil yield was found with application of NPK @ 110:60:50 kg ha^{-1} with sulphur @ 25 kg ha^{-1} (116.7 kg ha^{-1}) which was significantly superior over all other treatment combinations and followed by NPK @ 110:60:50 kg ha-1 with GA3 @ 200 ppm ha^{-1} (111.7 kg ha^{-1}). The lowest oil yield was found with control (55.3 kg ha^{-1}) treatment. The increase in oil yield with application of sulphur and nutrients as these increases the vegetative growth of the crop and it leads to more oil yield also it might enhance the oil biosynthesis process through its direct and indirect role in plant metabolism, resulting in increased number of plant metabolites.

Net return (Rs ha^{-1}): Data pertaining to net return as influenced by fertilizer, sulphur, gibberellic acid and NPK foliar spray were calculated for different treatments of mentha (table 3). The data reveals that the maximum net return (Rs 86,258) were found with application of NPK @ 110:60:50 kg ha- 1 with sulphur @ 25 kg ha^{-1} and followed by NPK @ 110:60:50 kg ha^{-1} with GA3 @ 200 ppm ha^{-1} (Rs 81,303) while minimum net return (Rs 27,678) was recorded with control.

Table 1: Plant height (cm) and number of leaves per plant of mint as influenced by various nutrient management practices and gibberellic acid at different growth stages

Treatment	Plant height (cm)			Number of leaves plant^{-1}		
40DAP	40 DAP	80 DAP	At Harvest	40 DAP	80 DAP	At Harvest
T_1: Control	7.30	26.59	37.73	7.11	32.33	44.22
T_2: NPK @ 90:50:40 kg/ha	11.17	31.37	43.19	10.78	36.11	54.67
T_3: NPK @ 110:60:50 kg/ha	12.67	34.86	48.70	11.67	41.23	55.56
T_4: T2 + GA3 @ 140 ppm/ha	11.24	32.16	43.46	11.00	38.33	55.22
T_5: T3 + GA3 @ 200 ppm/ha	14.92	39.36	54.09	15.11	57.78	69.22
T_6: T_2 + foliar application of NPK (19:19:19) @ 0.5% with one application	10.87	29.50	42.08	9.89	34.78	49.22
T_7: T_3 + foliar application of NPK (19:19:19) @ 0.5% with two application	12.73	36.11	48.84	11.89	46.78	59.89
T_8: T_2 + Sulphur @ 15 kg/ha	14.41	37.36	50.14	12.22	50.33	60.78
T_9: T_3 + Sulphur @ 25 kg/ha	17.79	45.01	61.51	19.11	62.67	81.22
S.Em±	0.78	1.08	1.36	0.92	1.18	3.03
CD(P=0.05)	2.37	3.27	4.12	2.77	3.58	9.18

Table 2: Crop growth rate (g m-2 day^{-1}) and specific leaf weight (g cm-2) of mint as influenced by various nutrient management practices and gibberellic acid at different growth stages

Treatment	Crop growth rate (g m^{-2} day^{-1})				Specific leaf weight (g cm^{-2})	
	0-30 DAP	30-60 DAP	60-90 DAP	90 DAP At harvest	40 DAP	80 DAP
T_1: Control	0.027	0.12	0.42	0.055	0.2	0.36
T_2: NPK @ 90:50:40 kg/ha	0.032	0.16	0.48	0.058	0.21	0.42
T_3: NPK @ 110:60:50 kg/ha	0.041	0.22	0.53	0.062	0.23	0.46
T_4: T_2 + GA3 @ 140 ppm/ha	0.036	0.18	0.50	0.060	0.22	0.43
T_5: T_3 + GA3 @ 200 ppm/ha	0.051	0.32	0.64	0.070	0.23	0.5
T_6: T_2 + foliar application of NPK (19:19:19) @ 0.5% with one application	0.029	0.12	0.44	0.056	0.21	0.39
T_7: T_3 + foliar application of NPK (19:19:19) @ 0.5% with two application	0.044	0.26	0.57	0.066	0.23	0.46
T_8: T_2 + Sulphur@15 kg/ha	0.048	0.30	0.61	0.068	0.23	0.47
T_9: T_3 + Sulphur@25 kg/ha	0.054	0.34	0.67	0.072	0.24	0.55
S.Em±	0.001	0.005	0.006	0.002	0.015	0.021
CD (p = 0.05)	0.003	0.017	0.018	0.006	0.045	0.063

Table 3: Herbage yield (q ha^{-1}), oil yield (kg ha^{-1}) and net return (Rs ha^{-1}) of mint as influenced by various nutrient management practices and gibberellic acid

Treatment	Herbage yield (q ha^{-1})	Oil yield (kg ha^{-1})	Net return (Rs ha^{-1})
T_1: Control	97.5	55.3	27,678
T_2: NPK @ 90:50:40 kg/ha	109.2	70.0	38,614
T3: NPK @ 110:60:50 kg/ha	129.2	85.0	53,383
T_4: T_2 + GA3 @ 140 ppm/ha	119.3	75.0	43,804
T_5: T_3 + GA3 @ 200 ppm/ha	154.2	111.7	81,303
T_6: T_2 + foliar application of NPK (19:19:19) @ 0.5% with one application	101.6	63.3	35,929
T_7: T_3 + foliar application of NPK (19:19:19) @ 0.5% with two application	136.9	96.7	64,883
T_8: T_2 + Sulphur @ 15 kg/ha	146.7	105.6	75,723
T_9: T_3 + Sulphur @ 25 kg/ha	158.4	116.7	86,258
S.Em±	0.22	1.04	-
CD (p = 0.05)	0.66	3.13	-

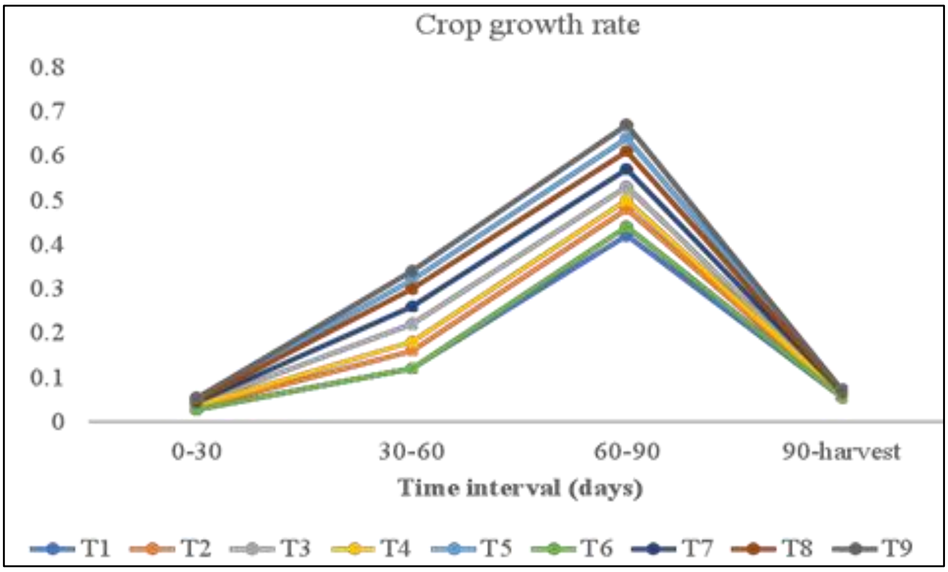

Fig 1: Crop growth rate of mint as influenced by various nutrient management practices and gibberellic acid at different growth stages

Conclusion

In the present investigation, the study revealed that the effect of various nutrient management practices and gibberellic acid application on Japanese mint indicates that it was significantly influence the various growth and yield parameters *viz*., plant height, number of leaves plant^{-1}, crop growth rate, specific leaf weight, herbage yield and oil yield. Maximum value of above parameters was recorded with application of T9 (NPK @ 110:60:50 kg ha^{-1} with sulphur @ 25 kg) which was followed by T5 (NPK @ 110:60:50 kg ha^{-1} with GA3 @ 200 ppm ha^{-1}). Apart from this, T_1 (control) showed lowest performance in all parameters in almost all stages of plant growth.

References

1. Abbas JA. Effect of nitrogenous and phosphate fertilizers of the properties on the vegetative growth and oil yield of local mint (*Mentha spicata* L.). Am - Eurasian J Sustain. Agric. 2009;3(2):262-265.
2. Anwar M, Chand S, Patra DD. Effect of graded level of NPK on fresh herb yield, oil yield and oil composition of six cultivars of menthol mint. Indian J Natural Pro. Res. 2010;1(1):74-79.
3. Bano U, Khan AF, Mujeeb F, Maurya N, Tabassum H, Siddiqui MH, *et al*. Effect of plant growth regulators on essential oil yield in aromatic plants. Journal of Chemical and Pharmaceutical Research. 2016;8(7):733-739.
4. Deepak BR, Padma M, Prabhakarand BN, Vijaya D. Effect of NPK, zinc and sulphur levels on oil yield of Japanese mint (*Mentha arvensis* L.) var. Kosi. Journal of Pharmaceutical Phytochemistry. 2019;8(4):3412-3415.
5. Kumar A, Patro HK, Anand K. Effect of zinc and sulphur on herb, oil yield and quality of menthol mint (*Mentha arvensis* L.) var. Kosi. Journal of Chemical and Pharmaceutical Research. 2010;2(4):642-648.
6. Rahman KM, Sattar MA, Rahman GMM. Effect of fertilizer and manures on growth and yield of tulsi and pudina medicinal plant. Journal of Environmental Science and Natural Resources. 2014;7(2):13-16.
7. Ram D, Ram D, Rawat G. Effect of moisture regimes, nitrogen rates and organic mulch on growth, accumulation pattern and yield of essential oil in menthol mint. J Indian perf. 2010;54(4):109-121.
8. Shekhar I, Daniel S, Kishore P, Singh AK, Kanaujia A. Impact of fertilizer dose and spacing on oil yield of Japanese mint (*Mentha arvensis* L.) var. Sarj. Journal of Pharmacognosy and Phytochemistry. 2018;7(4):2463-2465.