Plant Archives Vol. 25, Supplement 1, 2025 pp. 2425-2429 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2025.v25.supplement-1.332

EFFECT OF FOLIAR APPLICATION OF PDKV GRADE II MICRONUTRIENTS ON YIELD, QUALITY AND ECONOMICS OF WATERMELON

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(Date of Receiving : 14-10-2024; Date of Acceptance : 10-12-2024)

ABSTRACT

A field experiment was carried out to study the "Effect of foliar application of PDKV grade II micronutrients on yield, quality and economics of watermelon" at Instructional Farm, Department of Vegetable Science during *Summer* season of 2023. The experiment was comprised of twelve treatment combinations replicated thrice and laid out in Factorial Randomized Block Design. The treatment combinations were created by combining factor A (foliar application at 30, 40 and 50 DAT) and factor B (control, 2.5, 5.0 and 10.0 ml/L micronutrients) respectively. The data were recorded to find out suitable dose of foliar application of micronutrients to obtain better yield, quality and economics of watermelon. It was observed that, the foliar application of 5 ml/L micronutrients at 30 DAT (D_1M_2) resulted in maximum number of fruits per vine (2.90), average fruit weight (3.39 kg), fruit yield per vine (9.84 kg) and yield per hectare (492.07 q/ha), TSS (10.77 °Brix), reducing sugar (3.25 %), non-reducing sugar (5.27 %), total sugar (8.52) and highest B:C (3.03) ratio was noticed under the same treatment.
Keywords **:** Watermelon, Micronutrients, Foliar application, yield, quality

Introduction

Watermelon [*Citrullus lanatus* (Thunb.) Matsumet Nakai] is the most widely cultivated cucurbit in the world having chromosome number 2n=22. China is largest watermelon producer in the world with 60.86 million tonnes production per year. In India, watermelon accounts an area 0.12 million ha with production 3.225 million metric tonnes. In Maharashtra, area accounts 4850 ha and production 0.11 million tonnes (Anonymous 2022-23). It is a large, sprawling annual vine with coarse, hairy pinnately-lobed leaves and yellow flowers. It is grown for its edible fruit, which is a special kind of berry botanically called a pepo. It varies in shape from globular to oblong. Fruit juice is deep red to pink in colour with small black seeds embedded in the middle third of the flesh (Wehner *et al.,* 2001). Dry weather during ripening with high temperature, enough sunshine and dry wind favorable the development of flavour and accumulation of sugar in watermelon fruit. It requires 28^0 C to 30^0 C temperature for better plant growth, while fruiting is better at 24^0 C to 27^0 C.

Micronutrient play a crucial role in agriculture, contributing to increased crop productivity and quality (Tirpathi *et al.,* 2015). The nutrient element which are required comparatively in small quantities are called as micro or minor nutrient or trace elements. Micronutrient such as boron, iron, copper, zinc, manganese, and molybdenum are vital for plant health. It improves the chemical composition and general

condition of vegetable crops and are known to acts as catalyst in promoting various organic reaction in plants (Karthick *et al.,* 2018). Foliar spray with micronutrients is one way to improve production and reduce environmental risks among other methods of application of plant nutrients. Foliar micronutrient application is considered essential for increased yield and improved fruit composition. Foliar application is an efficient technique because the nutrients are absorbed rapidly, supplying the needs of plants, increasing production and quality of the products. Watermelon flowers are viable for a short period so it is most important to supply of boron during pollination which helps in higher fruit setting. In order to know appropriate availability of micronutrients through foliar spray, present investigation had been carried out.

Materials and Methods

The research trial was taken up during *summer* season of 2023 at Instructional farm, Department of Vegetable Science, Dr. PDKV, Akola. The experiment was laid out in Factorial Randomized Block Design (FRBD) with two factor and twelve treatment combinations with three replications. The treatment combinations were created by combining factor A (foliar application at 30, 40 and 50 DAT) and factor B PDKV grade II micronutrients (control, 2.5, 5.0 and 10.0 ml/L) *viz.,* D_1M_0 (Foliar spray 30 DAT + Control), D_1M_1 (Foliar spray 30 DAT + 2.5 ml/L), D_1M_2 (Foliar spray 30 DAT + 5.0 ml/L), D_1M_3 (Foliar spray 30 DAT + 10.0 ml/L), D_2M_0 (Foliar spray 40 DAT + Control), D_2M_1 (Foliar spray 40 DAT + 2.5 ml/L), D_2M_2 (Foliar spray 40 DAT + 5.0 ml/L), D_2M_3 (Foliar spray 40 DAT + 10.0 ml/L), D_3M_0 (Foliar spray 50 DAT + Control), D_3M_1 (Foliar spray 50 DAT + 2.5 ml/L), D_3M_2 (Foliar spray 50 DAT + 5.0 ml/L), D_3M_3 (Foliar spray 50 DAT + 10.0 ml/L). During experimentation regular irrigation, weeding and plant protection measures were followed as per need of crop. Data on yield, quality and economics attributes were collected from five randomly selected plants from each treatment in each plot at appropriate stages. The data obtained on various parameters were statistically analyzed by Factorial Randomized Block Design by Panse and Sukhatme (1985).

Results and Discussion

Yield parameters

Effect of time of foliar application

The data presented in Table 1 revealed that the yield parameters *viz.,* number of fruits per vine (2.47), average fruit weight (3.00 kg), fruit yield per vine (8.26 kg) and yield per hectare (413.03 q/ha) were recorded maximum in treatment D_1 *i.e.* foliar spray 30 DAT. Foliar applications at early stage provide nutrients during the yield potential determining time frame of plant development, which influenced the post-reproductive development stages. These outcomes are similar to findings of Patil *et al.* (2013) in bitter gourd, Bommesh *et al.* (2016) in cucumber, Tayade *et al.* (2022) and Jayashri *et al.* (2018) in watermelon.

Effect of levels of micronutrients

From the data Table 1 showed that the effect of levels of micronutrients on yield parameters. Yield attributing parameters *viz.,* number of fruits per vine (2.79), average fruit weight (3.08 kg), fruit yield per vine (8.62 kg) and yield per hectare (430.97 q/ha) were found maximum in treatment M_2 @ 5 ml/L micronutrients. There were increase in yield per hectare due to foliar application of micronutrients which promotes root growth and increased higher yield per hectare. Foliar application of micronutrients involves in accumulation of carbohydrates as the result of photosynthesis and efficient translocation of food reserves from source to sink resulting in increased yield and yield contributing parameters. Similar results found by Bommesh *et al.* (2016) in cucumber, Zahed *et al.* (2021), Tayade *et al.* (2022) in watermelon.

Interaction effect of time of foliar application and levels of micronutrients

The data pertaining to interaction effect of time of foliar application and levels of micronutrients on yield parameters is given in Table 1. Yield parameters *viz.,* number of fruits per vine (2.90), average fruit weight (3.39 kg), fruit yield per vine (9.84 kg) and yield per hectare (492.07 q/ha) were recorded maximum in treatment combination D_1M_2 *i.e.*, foliar spray 30 DAT + 5 ml/L micronutrients. Whereas minimum number of fruits per vine (2.53), average fruit weight (2.79 kg), fruit yield per vine (7.06 kg) and yield per hectare (352.87 q/ha) were recorded in treatment combination D_1M_0 *i.e.*, water spray (Control). Essential micronutrients like boron, zinc and iron play an important role in enzymatic reactions and act as catalysts in plant which responsible for increasing fruit set. Foliar application of micronutrients at vegetative crop stage involves in metabolic function efficiency leading to increased protein assimilation and carbohydrate which resulted in increased yield. These findings similar with Bharathi *et al.* (2018) in bitter gourd, Trinadh *et al.* (2022) in ivy gourd, Patidar *et al.* (2016) in cucumber, Vasantkumar *et al.* (2012), Tayade *et al.* (2022) and Jayashri *et al.* (2018) in watermelon.

Quality parameters

Effect of time of foliar application

The data on quality parameters are presented in Table 2 revealed that the TSS (9.88 ^{0}Brix), reducing sugar (2.88 %), non-reducing sugar (4.54 %) and total sugar (7.42 %) recorded maximum in treatment D_1 *i.e*., foliar spray 30 DAT. Similar findings have been made by Patil *et al.* (2013) in bitter gourd, Bommesh *et al.* (2016) in cucumber, Tayade *et al*. (2022) and Jayashri *et al.* (2018) in watermelon.

Effect of levels of micronutrients

The data represented in Table 2, Maximum TSS (9.96 ^{0}Brix), reducing sugar (2.95 %), non-reducing sugar (4.68 %) and total sugar (7.63 %) showed in treatment M_2 @ 5 ml/L micronutrients. Foliar application of micronutrients which promotes root growth and increases reducing sugar attributed to higher synthesis of carbohydrates due to zinc and boron level, findings related to Tayade *et al.* (2022), Jayashri *et al.* (2018), Rastogi and Abidi (2006) and Shao-ping *et al.* (2011) in watermelon.

Interaction effect of time of foliar application and levels of micronutrients

The data from Table 2 indicated that, the treatment combination of D_1M_2 – foliar application of 5 ml/L micronutrients at 30 DAT recorded maximum TSS (10.77 ^{0}Brix), reducing sugar (3.25 %), non-reducing sugar (5.27 %) and total sugar (8.52 %) as compared to water spray (Control) recorded minimum TSS (9.40 ^{0}Brix), reducing sugar (2.59 %), non-reducing sugar (4.12 %) and total sugar (6.72 %). Foliar application of micronutrients like boron, zinc and manganese enhances sucrose synthesis and iron and copper play role sugar metabolism ensuring proper sugar distribution and accumulation in fruit. The results are in the line with the findings of Tayade *et al*. (2022), Jayashri *et al.* (2018), Rastogi and Abidi (2006) in muskmelon and Shao-ping *et al.* (2011) in watermelon.

Economics

Benefits Cost ratio

The gross return, net return and benefit cost ratio were showed in Table 3. Significantly higher benefit cost ratio (3.03) found in the treatment combination of D_1M_2 *i.e.,* foliar application of 5 ml/L micronutrients at 30 DAT and minimum benefit cost ratio (2.18) noticed in water spray (Control) D_1M_0. These results are in accordance with the findings of Patil *et al.* (2013), Bharathi *et al.* (2018), Singh *et al.* (2021) in bitter gourd, Tayade *et al.* (2022) in watermelon and Trinadh *et al.* (2022) in ivy gourd.

Conclusion

From the present investigation, it can be concluded that, the yield attributes *viz.*, number of fruits per vine, average fruit weight, fruit yield per vine and yield per hectare were recorded maximum in treatment combination of foliar application of 5 ml/L micronutrients at 30 DAT. The qualitative parameters *viz.*, TSS, reducing sugar, non-reducing sugar and total sugar and higher benefit cost ratio were found significant due to interaction effect of foliar application of 5 ml/L micronutrients at 30 DAT. Therefore, it was found that foliar application of 5 ml/L PDKV grade II micronutrients at 30 DAT effective to increase overall yield, nutritional quality and economic feasibility of watermelon.

Table 1 : Number of fruits per vine, average fruit weight (kg), fruit yield per vine (kg) and yield per ha (q/ha) as influenced by time of foliar application and levels of micronutrients in watermelon

	Number of fruits per vine					Average fruit weight (kg)					Fruit yield per vine (kg)					Yield per ha (q/ha)				
Treatment	**Micronutrients (M)**					**Micronutrients (M)**					**Micronutrients (M)**					**Micronutrients (M)**				
Foliar spray DAT (D)	**M_0**	**M_1**	**M_2**	**M_3**	**Mean**	**M_0**	**M_1**	**M_2**	**M_3**	**Mean**	**M_0**	**M_1**	**M_2**	**M_3**	**Mean**	**M_0**	**M_1**	**M_2**	**M_3**	**Mean**
D_1	2.53	2.73	2.90	2.80	2.74	2.79	2.97	3.39	2.86	3.00	7.06	8.13	9.84	8.02	8.26	352.87	406.40	492.07	400.80	413.03
D_2	2.70	2.87	2.63	2.73	2.73	2.81	3.10	2.99	2.88	2.95	7.60	8.89	7.87	7.88	8.06	379.77	444.33	393.70	394.13	402.98
D_3	2.60	2.70	2.83	2.67	2.70	2.84	2.91	2.87	2.90	2.88	7.39	7.85	8.14	7.74	7.78	369.33	392.47	407.13	387.15	389.02
Mean	2.61	2.77	2.79	2.73		2.81	2.99	3.08	2.88		7.35	8.29	8.62	7.88		367.32	414.40	430.97	394.03	
	D		**M**		**D × M**	**D**		**M**		**D × M**	**D**		**M**		**D × M**	**D**		**M**		**D × M**
F test	**NS**		**Sig.**		**Sig.**	**Sig.**		**Sig.**		**Sig.**	**Sig.**		**Sig.**		**Sig.**	**Sig.**		**Sig.**		**Sig.**
SE (m) ±	0.03		0.04		0.06	0.02		0.02		0.04	0.11		0.13		0.23	5.87		6.77		11.73
CD at 5%	-		0.10		0.18	0.05		0.06		0.11	0.33		0.38		0.66	17.20		19.86		34.41

Table 2 : TSS, Reducing, non-reducing and total sugar as influenced by time of foliar application and levels of micronutrients in watermelon

	TSS (^{0}Brix)					Reducing sugar (%)					Non-reducing sugar (%)					Total sugar (%)				
Treatment	**Micronutrients (M)**					**Micronutrients (M)**					**Micronutrients (M)**					**Micronutrients (M)**				
Foliar spray DAT (D)	**M_0**	**M_1**	**M_2**	**M_3**	**Mean**	**M_0**	**M_1**	**M_2**	**M_3**	**Mean**	**M_0**	**M_1**	**M_2**	**M_3**	**Mean**	**M_0**	**M_1**	**M_2**	**M_3**	**Mean**
D_1	9.40	9.80	10.77	9.54	9.88	2.59	2.77	3.25	2.92	2.88	4.12	4.35	5.27	4.40	4.54	6.72	7.13	8.52	7.32	7.42
D_2	9.63	10.35	9.50	9.48	9.74	2.60	3.20	2.89	2.72	2.85	4.22	5.19	4.34	4.39	4.53	6.82	8.38	7.23	7.11	7.38
D_3	9.74	9.63	9.60	9.78	9.69	2.61	2.75	2.71	2.69	2.69	4.20	4.33	4.42	4.38	4.33	6.82	7.08	7.13	7.06	7.02
Mean	9.59	9.93	9.96	9.60	9.77	2.60	2.91	2.95	2.78		4.18	4.62	4.68	4.39		6.78	7.53	7.63	7.16	
	D		**M**		**D × M**	**D**		**M**		**D × M**	**D**		**M**		**D × M**	**D**		**M**		**D × M**
F test	**Sig.**		**Sig.**		**Sig.**	**Sig.**		**Sig.**		**Sig.**	**Sig.**		**Sig.**		**Sig.**	**Sig.**		**Sig.**		**Sig.**
SE (m) ±	0.05		0.05		0.09	0.05		0.05		0.09	0.01		0.01		0.03	0.04		0.05		0.09
CD at 5%	0.14		0.16		0.27	0.14		0.16		0.27	0.04		0.04		0.07	0.13		0.15		0.26

Table 3 : Benefit cost ratio influenced by time of foliar application and levels of micronutrients

Treatment	Yield per ha (q)	Total cost (Rs. /ha)	Gross return (Rs.)	Net return (Rs.)	B: C ratio
D_1M_0	352.87	162149	352866.67	190717.67	2.18
D_1M_1	406.40	162163	406400.00	244237.00	2.51
D_1M_2	492.07	162429	492066.67	329637.67	3.03
D_1M_3	400.80	162709	400800.00	238091.00	2.46
D_2M_0	379.77	162149	379766.67	217617.67	2.34
D_2M_1	444.33	162163	444333.33	282170.33	2.74
D_2M_2	393.70	162429	393700.00	231271.00	2.42
D_2M_3	394.13	162709	394133.33	231424.33	2.42
D_3M_0	369.33	162149	369333.33	207184.33	2.28
D_3M_1	392.47	162163	392466.67	230303.67	2.42
D_3M_2	407.13	162429	407133.33	244704.33	2.51
D_3M_3	387.15	162709	387150.00	224441.00	2.38

Acknowledgment

I am thankful to Dr. A. M. Sonkamble, Professor and Head of Department of Vegetable Science, Dr. PDKV, Akola for providing all the necessary facilities for conducting the research work.

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