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Jeenal S Vora

Department of Vegetable
Science, College of Horticulture,
Junagadh Agricultural
University, Junagadh, Gujarat,
India

KD Patel

Principal, Polytechnic in
Horticulture, Junagadh
Agricultural University,
Junagadh, Gujarat, India

HJ Senjaliya

Assistant Professor, Department
of Vegetable Science, College of
Horticulture, Junagadh
Agricultural University,
Junagadh, Gujarat, India

HV Vasava

Assistant Professor, Department
of Vegetable Science, College of
Horticulture, Junagadh
Agricultural University,
Junagadh, Gujarat, India

Effect of different levels of NPK on yield and quality of drumstick (*Moringa oleifera* L.) CV. PKM-1

Jeenal S Vora, KD Patel, HJ Senjaliya and HV Vasava

Abstract

The present research was carried out at Lal Baugh Farm, College of Horticulture, Junagadh Agricultural University, in the year 2021-22. The results indicated that among three levels of nitrogen, N₃ (80 g/plant) demonstrated maximum number of pods per plant (141.67), pod yield (11.32 kg/plant), pod yield (12.57 t/ha), fresh weight (79.46 g), dry weight (18.53 g), pod girth (4.68 cm), pod length (61.19 cm), number of seeds per pod (18.80) and nitrogen content of pod (2.05%). While, N₁ (40 g/plant) gave fiber content of pod (46.40%). Regarding phosphorus, P₂ (30 g/plant) gave number of pods per plant (138.91), pod yield (10.49 kg/plant), pod yield (11.65 t/ha), fresh weight (74.54 g), dry weight (17.64 g), pod girth (4.55 cm), pod length (61.44 cm), number of seeds per pod (18.68), phosphorus content of pod (0.73%) and fiber content (45.15%). The results indicated that among three levels of potash, K₃ (45 g/plant) gave maximum number of pods per plant (140.36), pod yield (10.84 kg/plant), pod yield (12.05 t/ha), fresh weight (76.33 g), dry weight (17.55 g), pod girth (4.56 cm), pod length (60.84 cm), number of seeds per pod (18.62), potassium content of pod (1.98%) and fiber content (45.17%).

Keywords: Drumstick, nitrogen, phosphorous, potassium, levels, yield, quality

Introduction

Drumstick botanically known as *Moringa oleifera* L., has experienced a surge in popularity in recent times. This surge in interest is largely attributed to the discovery of its numerous benefits for mankind. People are becoming increasingly aware of the usefulness of drumstick, leading to its rapid growth in popularity. Moringa is preferred in the market throughout the year. Drumstick is known for its rich content of vitamins, minerals, and antioxidants, making it a valuable addition to a healthy diet. It has been found to possess anti-inflammatory and anti-cancer properties, further contributing to its rising popularity. According to the scientific records, moringa leaves contain twice the protein of yogurt, 7 times the vitamin C of oranges, 4 times the calcium of milk, 4 times the vitamin A found in carrots and 3 times the iron found in almonds, 3 times the potassium in banana and 2 times the protein in milk (Fahey, 2005) [5]. Hence, moringa plant can be considered as a powerhouse of nutritional value (Moyo *et al.*, 2011) [12]. The increasing demand for drumstick has led to the cultivation of this tree in various parts of the world. Despite its potential, drumstick has received insufficient attention as a crop, resulting in a scarcity of research and development efforts focused on crop improvement and production technology.

Fertilizer management is one of the important factors for bringing a significant increase in crop yield and quality. The nutritional requirements of drumstick differ significantly from those of annual and biennial vegetable crops. Drumstick has its unique set of nutrient needs. Addressing these specific nutritional requirements is essential for successful cultivation and maximizing the potential yield and quality of drumstick plants.

Materials and Methods

The study was performed during the year 2021-22 at Baugh farm, College of Horticulture, Junagadh Agricultural University, Junagadh. The area falls under the South Saurashtra Agro Climatic Zone-VII of Gujarat state.

The experiment was laid out in Factorial Randomized Block Design (FRBD) with three replications. Pruning was done at 2 m height on second fortnight of October. The experiment consisted of 18 treatment combinations involving three levels of nitrogen (N) at N₁: 40 g/plant, N₂: 60 g/plant, and N₃: 80 g/plant. Additionally, two levels of phosphorus (P) were applied, namely P₁: 15 g/plant and P₂: 30 g/plant, along with three levels of potassium (K) at K₁: 15 g/plant, K₂: 30 g/plant, and K₃: 45 g/plant. Following the pruning process, farmyard manure (FYM) was applied at a rate of 20 kg/plant.

Corresponding Author:

Jeenal S Vora

Department of Vegetable
Science, College of Horticulture,
Junagadh Agricultural
University, Junagadh, Gujarat,
India

Half of the nitrogen dose, along with the full dose of phosphorus and potassium, was administered based on the specific treatment combination. The remaining nitrogen dose was applied after 50% flowering.

The recorded observations included the number of the maximum number of pods per plant, maximum pod yield in terms of kilograms per plant and tons per hectare, maximum fresh weight, maximum dry weight, maximum pod girth, maximum pod length, maximum number of seeds per pod, maximum NPK content of pod and maximum fiber content. The obtained data was subjected to statistical analysis using variance analysis according to FRBD by Panse and Sukhatme (1985) [14].

Result and Discussion

Effect of nitrogen (N)

Yield parameters

In case of different level of nitrogen significantly maximum number of pods per plant (141.67) followed by 135.75 (N₂), pod yield per plant (11.32 kg) and pod yield per hectare (12.57 t) was obtained in N₃ (80 g/plant). The result of present finding is supported by the previous research findings Khan *et al.* (2000) [19] in okra and Vaishapayan and Joshi (2003) [19] in moringa.

Quality parameters

Significantly maximum fresh weight (79.46 g), dry weight (18.53 g), maximum pod girth (4.68 cm) followed by 4.54 cm (N₂), pod length (61.19), more number of seeds per pod (18.80) followed by 59.40 cm (N₂) was obtained with high dose of N₃ (80 g/plant). The finding might be due to sustained availability of nitrogen in the soil throughout the growing phase and also due to enhanced synthesis of carbohydrates and effective translocation of these photosynthates to the sink (pod). High nitrogen content of pod (2.05%) also recorded with N₃. While maximum fiber content (46.40%) was observed with application of N₁ (40 g/plant). The decrease in crude fiber content was due to the increase in succulence by the increased application of nitrogen. These results are in conformity with those reported by Irene *et al.* (1990) [7] in okra, Shinde *et al.* (2010) [16] in cucumber and Suresh *et al.* (2011) in custard apple.

Effect of phosphorus (P)

Yield parameters

Significantly maximum number of pods per plant (138.91), pod yield per plant (10.49 kg) and pod yield per hectare (11.65 t) was obtained in P₂ (30 g/plant). It was concurrence with the findings of Kumar *et al.* (2004) [10] in ridge gourd and Aryal *et al.* (2021) [1] in cow pea.

Quality parameters

Significantly maximum fresh weight (74.54 g), dry weight (17.64 g), pod girth (4.55 cm), pod length (61.44 cm), maximum seeds number per pod (18.68), high phosphorus content (0.73%) in pod, maximum fiber content (45.15%) was recorded with highest dose of P₂ (30 g/plant). This was also

due to the beneficial effect at optimum levels of phosphorus which stimulates plant processes, *viz.* cell division and cell expansion. Similar results found by Tewari *et al.* (2000) [18] in French bean and Muhammad *et al.*, (2009) [13] in guar gum.

Effect of potassium (K)

Yield parameters

Significantly maximum number of pods per plant (140.36), pod yield per plant (10.84 kg) and pod yield per hectare (12.05 t/ha) was found in K₃ (45 g/plant). These results are in conformity with those reported by Goswamy *et al.* (1997) [6] in spine gourd and Choudhari and More (2002) [3] in cucumber.

Quality parameters

Significantly maximum fresh weight (76.33 g), dry weight (17.55 g), highest pod girth (4.56 cm), pod length (60.84 cm), number of seeds per pod (18.62), highest potassium contents (1.98%) and maximum fiber content (45.17%) was reported with application of high levels of K₃ (45 g/plant). The observed variation might be due to potential of high rate of potash to accelerate enzyme activity which lead to synthesis of protein and assimilate translocation. The results are in conformity with the findings of Dutta and Banik (2007) [4] in guava and Moniruzzaman *et al.* (2008) [11] in French bean.

Interaction effect of NPK

Yield parameters

Nitrogen and phosphorus had a significant effect on the number of pods per plant. The highest number of pods per plant (147.44) was observed when N₂P₂ (60 g/plant and 30 g/plant) was applied, followed by N₃P₂ with 147.00 pods. This could be attributed to the sufficient supply of nitrogen and phosphorus, which enhanced photosynthesis and the transport of nutrients to the pods, resulting in a significant increase in pod number. However, excessive nitrogen led to excessive vegetative growth, causing a decrease in pod formation. The application of nitrogen and potassium also had a significant impact on pod yield. The highest pod yield (12.82 kg/plant and 14.24 t/ha) was achieved with N₃K₃ (80 g/plant and 45 g/plant), followed by 11.95 kg/plant and 13.28 t/ha with N₂K₃. This increased yield can be attributed to the role of these nutrients in various metabolic processes, nutrient transport, improved plant growth, and increased accumulation of photosynthates. Similar findings were also reported by Vijai *et al.* (1990) [20] in garden pea and Kaiser *et al.* (2007) [8] in French bean.

Quality parameters

Among the different doses significantly maximum fresh weight (85.15 g) was observed with application of N₃K₃ (80 g/plant and K 45 g/plant) followed by 80.85 g and 79.55 g in (N₂K₃) and (N₃K₂). It might be because of the role played by this nutrient in various metabolic processes and translocation of metabolites. These results are in conformity with those reported by Pathak and Pundir (1981) [15] in pomegranate and Chatzitheodorou *et al.* (2004) [2] in peach.

Table 1: Effect of different levels of NPK on yield parameters of drumstick

Treatment	Number of pods per plant	Pod yield (kg/plant)	Pod yield (t/ha)
Nitrogen (N)			
N ₁ : 40 g/plant	118.64	7.27	8.08
N ₂ : 60 g/plant	135.75	10.03	11.14
N ₃ : 80 g/plant	141.67	11.32	12.57
S. Em ±	2.265	0.242	0.269
C. D. at 5%	6.51	0.70	0.77
Phosphorus (P)			
P ₁ : 15 g/plant	125.13	8.59	9.54
P ₂ : 30 g/plant	138.91	10.49	11.65
S. Em ±	1.849	0.198	0.220
C. D. at 5%	5.31	0.57	0.63
Potassium (K)			
K ₁ : 15 g/plant	123.31	8.32	9.24
K ₂ : 30 g/plant	132.39	9.46	10.51
K ₃ : 45 g/plant	140.36	10.84	12.05
S. Em ±	2.265	0.242	0.269
C. D. at 5%	6.51	0.70	0.77
C. V. %	7.28	10.78	10.79

Table 2: Effect of different levels of NPK on quality parameters of drumstick

Treatment	Fresh weight of pod (g)	Dry weight of pod (g)	Pod girth (cm)	Pod length (cm)	Number of seeds per pod	NPK content (%)			Fiber content (%)
						N	P ₂ O ₅	K ₂ O	
Nitrogen (N)									
N ₁ : 40 g/plant	61.13	14.91	4.04	57.36	17.18	1.67	0.70	1.84	46.40
N ₂ : 60 g/plant	73.02	17.02	4.54	59.40	17.74	1.84	0.71	1.86	44.54
N ₃ : 80 g/plant	79.46	18.53	4.68	61.19	18.80	2.05	0.72	1.87	40.39
S. Em ±	0.981	0.260	0.068	0.903	0.312	0.025	0.010	0.024	0.662
C. D. at 5%	2.82	0.75	0.19	2.60	0.90	0.07	NS	NS	1.90
Phosphorus (P)									
P ₁ : 15 g/plant	67.87	16.00	4.29	57.20	17.14	1.84	0.68	1.83	42.42
P ₂ : 30 g/plant	74.54	17.64	4.55	61.44	18.68	1.86	0.73	1.88	45.15
S. Em ±	0.801	0.212	0.055	0.737	0.255	0.020	0.008	0.019	0.541
C. D. at 5%	2.30	0.61	0.16	2.12	0.73	NS	0.02	NS	1.55
Potassium (K)									
K ₁ : 15 g/plant	66.83	16.02	4.28	57.56	17.24	1.80	0.69	1.70	42.19
K ₂ : 30 g/plant	70.45	16.90	4.42	59.55	17.87	1.86	0.71	1.89	43.98
K ₃ : 45 g/plant	76.33	17.55	4.56	60.84	18.62	1.89	0.73	1.98	45.17
S. Em ±	0.981	0.260	0.068	0.903	0.312	0.025	0.010	0.024	0.662
C. D. at 5%	2.82	0.75	0.19	2.60	0.90	NS	NS	0.07	1.90
C. V. %	5.84	6.56	6.49	6.46	7.40	5.64	5.76	5.42	6.42

Table 3: Interaction effect of N x P on yield and quality parameters of drumstick

Treatment	Number of pods per plant	
	P ₁	P ₂
N ₁	115.00	122.28
N ₂	124.06	147.44
N ₃	136.33	147.00
S. Em ±	3.203	
C. D. at 5%	9.21	
C. V. %	7.28	

Table 4: Interaction effect of N x K on yield and quality parameters of drumstick

Treatment	Fresh weight of pod (g)			Pod yield (kg/plant)			Pod yield (t/ha)		
	K ₁	K ₂	K ₃	K ₁	K ₂	K ₃	K ₁	K ₂	K ₃
N ₁	59.38	61.01	63.00	6.75	7.30	7.77	7.50	8.11	8.63
N ₂	67.42	70.78	80.85	8.44	9.69	11.95	9.38	10.77	12.28
N ₃	73.67	79.55	85.15	9.75	11.38	12.82	10.83	12.65	14.24
S. Em ±	1.70			0.42			0.47		
C. D. at 5%	4.88			1.21			1.34		
C. V. %	5.84			10.78			10.79		

Conclusion

The results clearly demonstrated that treatment N₃ (80 g/plant) has proven to be a highly effective approach in maximizing

the number of pods and yield as well as enhancing the length and girth of pods. Further gave maximum number of seeds per pod and maximum NPK contain of pod while maximum

fiber contain of pod were obtained with N₁. Treatments P₂ (30 g/plant) and K₃ (45 g/plant) emerged as the most successful in terms of pod production, yield, length, girth, number of seeds, NPK content of pods and fiber content of pod. Moreover interaction of nitrogen and potassium gave high quality yield.

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