The Pharma Innovation Journal 2022; 11(4): 450-453

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(4): 450-453

www.thepharmajournal.com
Received: 17-01-2022
Accepted: 28-02-2022

Vaqar Malik
M.Sc., Department of Plantation, Spices, Medicinal and Aromatic Crop, RVSKVV- KNK College of Horticulture, Mandsaur, Madhya Pradesh, India

IS Naruka
Professor, Department of Plantation, Spices, Medicinal & Aromatic Crop, RVSKVV- KNK College of Horticulture, Mandsaur, Madhya Pradesh, India

DK Raidas
Assistant Professor, Department of Plant Physiology, RVSKVV-RAK College of Agriculture, Sehore, Madhya Pradesh, India

Sikandar Malik
M.Sc., Department of Fruit Science, RVSKVV- KNK College of Horticulture, Mandsaur, Madhya Pradesh, India

Huda Khalil
M.Sc., Department of Plant Breeding & Genetics, RVSKVV-RAK College of Agriculture, Sehore, Madhya Pradesh, India

Corresponding Author:
Vaqar Malik
M.Sc., Department of Plantation, Spices, Medicinal and Aromatic Crop, RVSKVV- KNK College of Horticulture, Mandsaur, Madhya Pradesh, India

Study on morpho-physiological, yield and quality characteristics of turmeric (*Curcuma longa* L.) as influenced by plant geometry and cultivars

Vaqar Malik, IS Naruka, DK Raidas, Sikandar Malik and Huda Khalil

Abstract
The present field experiment was conducted at investigation carried out during *Kharif* + Rabi season of 2019-20 at the Herbal Garden, College of Horticulture, Mandsaur (M.P.). The experimental material comprised of nine treatment combinations of three plant spacing and three cultivars of turmeric. These treatments were sown in Factorial Randomized Block Design with four replications. The individual effect of planting geometry 45 × 30 cm (S_3) was recorded the maximum plant height, number of leaves, leaf area, dry weight of plant at harvest and number of tillers at 90 DAP. Similarly the physiological characteristic *viz*. LAI (1.086), CGR (1.043), RGR (0.348), LAD (36657.47) at 90-120 of growth stage and chlorophyll content (28.46 SPAD) at 90 DAP as compared to other plant spacing 45×25 cm (S_2) and 45×20 cm (S_1) respectively. The maximum yield *viz*. fresh rhizomes yield plant^{-1} were observed maximum in 45 × 30 cm (S_3) and fresh rhizomes yield ha^{-1} ((239.86)) were found maximum in S_1 (45 × 20 cm)) with quality parameter *viz*., oil content (4.13%) and curcumin content (5.49%) were observed maximum in S_3 (45 × 30 cm)). In case of cultivars, the Sonali (V_2) was significantly superior and was recorded maximum plant height, number of leaves, leaf area, dry weight of plant at harvest and number of tillers at 90 DAP. The physiological characteristics *viz* LAD (1.047), CGR (0.848), RGR (0.341), LAD (35348.78) at 90-120 growth stages and chlorophyll content (28.00 SPAD) as compared to other cultivars Suroma (V_1) and Ranga-3 (V_3). The yield characteristic *viz*. fresh rhizomes yield (300.86g) plant^{-1} and fresh rhizomes yield (242.94 q ha^{-1}) was observed with cultivar Sonali (V_2) as compare to cultivars Suroma (V_1) and Ranga-3 (V_3) and quality characteristics *viz*. was exhibited oil content (4.18%) and curcumin content (5.47%) of rhizomes was significantly higher with cultivars Sonali (V_2) in comparison to other cultivars.

Keywords: Plant height, chlorophyll content, leaf area index, fresh rhizomes yield, oil content, Curcumin content

Introduction
Turmeric (*Curcuma longa* L.) belongs to family Zingiberaceae. It is known as Golden spice of life. Turmeric is a native of South East Asia. It is a rhizomatous perennial herb grown as an annual plant. Turmeric is grown in both tropical and subtropical regions, have a preference for a warm and humid climate with temperature ranges from 20 °C to 35 °C. It is a great healer of wounds owing anti-inflammatory, anti tumor and anti-fungal properties. it is an excellent for treating skin diseases like acne, eczema, skin cancers etc. The rhizomes contain curcuminoids, curcumin and dihydrocurcumin which are found to be natural anti-oxidants. India contributes the largest share in the production (80%) and export (60%) of turmeric all over the world. Telangana, Maharashtra, Tamil Nadu, Andhra Pradesh, Karnataka, Orissa, West Bengal and Kerala are the major turmeric growing states in India. The total area under turmeric cultivation in India is about 237.96 thousand hectare with the production of 1132.72 thousand metric tons. In Madhya Pradesh having a production of 39.05 thousand metric tons and a productivity of (3.56 MT/ha) with a total area of 10.95 thousand hectares (Anonymous, 2018) [3]. Among the different factors affecting growth, yield and quality of turmeric, spacing and selection of cultivars appear to be the most important factors. Optimum spacing between plants enables better utilization of soil moisture, nutrient, solar radiation and all the available growth factors which ultimately affect nutrients uptake, growth and yield of plants. With an increase in spacing, the total population of plant per hectare decreases but in this condition the nutrition uptake increases which makes the individual plant grow better and yield more and vice-versa. Therefore, the increase and decrease in plant population as a result of a change in plant spacing both ways has a definite pattern in relation to the yield.

By adopting improved cultivars with maintaining the proper plant to plant and row to row spacing, a potential yield can be achieved (Bhadouria *et al*. 2014) [5]. The performance of any cultivar is largely depends upon It's genetically make up. The performance of the cultivar also depends upon climatic conditions of the region where it is grown. As a result, cultivars which perform well in one region may not perform well in other regions of varying climatic conditions. Hence, it is necessary to collect and evaluate the available cultivars for its suitability in the particular geographical conditions (Salimath *et al.*, 2014) [13].

Materials and Methods

The field experiment was carried out at the field of Herbal Garden, Department of Plantation, Spices, Medicinal and Aromatic Crops, KNK College of Horticulture, Mandsaur (M.P.) during Kharif + Rabi season of 2019-20 with Factorial Randomized Block Design with four replications. The experimental material consisting of nine configurations of cultivars (Suroma, Sonali and Ranga-3) with Spacing (45×20 cm, 45×25 cm and 45×30 cm). The half dose of nitrogen and the full dose of potassium and phosphorus were added as basal dressing, while the remaining half dose of nitrogen was applied as top dressing at 30 and 60 days after sowing, at two equivalent splits doses. Recommended cultivation practices were adopted to raise a normal crop. The five plants were collected from each plot at 60, 90, 120, 150 day after planting and at harvest to recorded all the parameters *viz*., plant height (cm) number of leaves plant^{-1}, number of tillers plant^{-1}, dry weight of plant (g) moisture content (%) of plant, chlorophyll content (SPAD value) and leaf area (cm^2). The chlorophyll content will be determined by using Minolata SPAD 502 plus Chlorophyll. The instrument measuring the relative amount of chlorophyll present in plant leaves in unit of SPAD (Soil Plant Analysis Development) and leaf area will be determined by laser area meter with conveyer attachment (LI-300). The leaf area index, crop growth rate (mg cm^{-2} day^{-1}), relative growth rate (mg g^{-1} day^{-1}) and leaf area duration (cm^2 day^{-1}) at an interval of 30 days starting from 60 days after sowing to harvest. The fresh rhizome yield was determined using electronic balance from the complete (mother, primary and secondary) rhizome weight of the sampled plants and was expressed in q ha^{-1}. The essential oil content was estimated as per the methods suggested by ASTA (Anonymous, 1968) [2] and curcumin content (%) determined by HPTLC method. Finally mean data of the all characters were computed for statistical analysis as per standard procedure given by (Panse and Sukhtme 1989) [11].

Result and Discussion

1. Influence on plant geometry: Wider plant spacing 45×30 cm (S_3) significantly increased the morphological characters *viz*. plant height (103.63cm) number of leaves plant^{-1} (15.72), leaf area plant^{-1} (1355.07), dry weight of plant (180.75g) at harvest and number of tillers plant^{-1} (7.42) at 90 DAP with physiological characters *viz*. leaf area index (1.086), crop growth rate (1.043), relative growth rate (0.348), leaf area duration (36657.47) at 90-120 of growth stages and chlorophyll content (28.46 SPAD value) at 90 DAP as compared to other plant spacing 45×25 cm (S_2) and 45×20 cm (S_1) at the growth stage respectively. However, moisture content (54.12%) were recorded higher but non-significant with the same spacing at the growth stages (Table-1). These significant variations may be attributed to vigorous vegetative growth, which resulted from favorable climatic condition including sun light, proper aeration, and proper nutritional environment in root zone as well as in the plant system. The vigorous growth in turmeric means production of more leaves, which helped in the synthesis of more photosynthates and thus resulting in increased accumulation of carbohydrates and other metabolites, which ultimately determined the size and weight of rhizomes (Bahadur *et al*. 2000) [4], (Singh *et al*. 2000) [15] and (Kumar and Gill (2010) [6]. In case of wider plant spacing 45×30 cm (S_3) significantly increased the yield attributes *viz*. number of mother rhizomes (2.37) plant^{-1}, number of primary rhizomes (8.93) plant^{-1}, number of secondary rhizomes (15.68) plant^{-1} and fresh rhizomes yield (311.60g) plant^{-1} in comparison to other plant spacing 45×25 cm (S_2) and 45×20 cm (S_1). The maximum rhizomes yield (239.86) ha^{-1} in case of spacing 45×20 cm (S_1) as compare to other plant spacing 45×25 cm (S_2) and 45×30 cm (S_3) data presented in (Table 2 and Fig. 1). Its might be due to more number of plants per unit area with vigorous and rapid growth of plant. These indicate that plant population is one of the most important factor for yield in turmeric (Pandey and Mishra 2009) [10], (Kumar and Gill 2010) [6] and (Bhadouria *et al.* 2014) [5]. In terms of quality of turmeric maximum essential oil (4.13%) and curcumin content (5.49%) was observed with the spacing 45x30 cm (S_3) as compare to other spacing 45x25 cm (S_2) and 45x20 cm (S_1) data presented in (Table 2 and Fig. 2). The positive influence of the wider spacing on essential oil content of rhizomes appears to be due to improved nutritional environment both in the root zone and plant system. (Naruka 2000) [8] and (Nautiyal *et al.* 2016) [9].

2. Influence on cultivars: Among the cultivars, Sonali (V_2) exhibited maximum plant height (100.58cm), number of leaves plant^{-1} (15.57), leaf area plant^{-1} (1306.24), dry weight of plant (165.17g) at harvest and number of tillers plant^{-1}(7.38) at 90 DAP. The physiological characteristics *viz.* leaf area index (1.047), crop growth rate (0.848), relative growth rate (0.341) and leaf area duration (35348.78) at 90-120 growth stages and chlorophyll content (28.00 SPAD value) as compared to other cultivars Suroma (V_1) and Ranga-3 (V_3) of growth stages. However, moisture content (51.13%) were recorded higher but non-significant with the same cultivar of the growth stages as compare to other cultivars data presented in (Table 1). This might be due to differences in their genotypic potential which influenced morphological expression expressed through the activity of endogenous growth regulators and better adaptability to soil and climate Similarly, in case of number of mother rhizomes plant^{-1}, number of primary rhizomes plant^{-1} and number of secondary rhizomes plant^{-1} and fresh rhizomes yield (300.86g) plant^{-1} with rhizomes yield (242.94) q ha^{-1} was observed with cultivar Sonali (V_2) as compare to cultivars Suroma (V_1) and Ranga-3 (V_3) data presented in (Table 2 and Fig. 1). this is due to because of growth attributes recorded in cultivar Sonali (V_2) is might be one of the reasons as these attributes contribute directly or indirectly towards yield and yield attributing characters (Singh and Verma 2013) [14], (Salimath *et al.* 2014) [13], (Rai *et al*. 2016) [12] and (Mariam *et al*. 2019) [7]. Essential oil content (4.18%) and Curcumin content (5.47%) of rhizomes was significantly higher with cultivars

Sonali (V_2) in comparison to other cultivars data presented in (Table 2 and Fig. 2). which might be due to the differences in their genotypic potential with respect to polygenic traits and adaptability to agro-climatic conditions where it is grown (Anburani, 2018) [1].

Table 1: Effect of plant geometry and cultivars on morpho-physiological characteristics of turmeric

Treatments	Morphological characteristics						Physiological characteristics				
	Plant height (cm)	Number of leaves plant^{-1}	Leaf area Plant^{-1} (cm^2)	Dry weight of plant (g)	Number of tillers plant^{-1}	Moisture content (%) of plant	LAI	CGR (mg cm^{-2} day^{-1})	RGR (mg g^{-1} day^{-1})	LAD (cm^2 day^{-1})	Chlorophyll Content (SPAD)
	At harvest	At harvest	At harvest	At harvest	90 DAP	At harvest	90-120 DAP	90-120 DAP	90-120 DAP	90-120 DAP	At 90 DAP
(45 x 20 cm)	93.15	15.17	1183.05	135.67	7.18	47.56	0.954	0.415	0.313	32209.45	27.23
(45 x 25 cm)	98.85	15.49	1284.66	159.27	7.33	49.43	1.021	0.823	0.341	34457.45	27.96
(45 x 30 cm)	103.63	15.72	1355.07	180.75	7.42	54.12	1.086	1.043	0.348	36657.47	28.46
S.Em ±	0.24	0.03	2.27	0.49	0.03	2.86	0.008	0.017	0.001	284.58	0.04
C.D. at 5%	0.71	0.08	6.66	1.46	0.08	NS	0.025	0.049	0.004	835.60	0.11
V_1 (Suroma)	98.59	15.38	1239.10	151.01	7.25	49.48	0.998	0.603	0.324	33688.80	27.70
V_2 (Sonali)	100.58	15.57	1306.24	165.17	7.38	50.51	1.047	0.848	0.341	35348.78	28.00
V_3 (Ranga-3)	96.47	15.43	1277.44	159.53	7.30	51.13	1.016	0.831	0.336	34286.80	27.94
S.Em ±	0.24	0.03	2.27	0.49	0.03	2.86	0.008	0.017	0.001	284.58	0.04
C.D. at 5%	0.71	0.08	6.66	1.46	0.08	NS	0.025	0.049	0.004	835.60	0.11

DAP- Days after planting, LAI- Leaf area index, CGR- Crop growth rate, RGR- Relative growth rate, LAD- Leaf area duration

Table 2: Effect of plant geometry and cultivars on yield and quality of Turmeric

Treatments	Yield characteristics					Quality characteristics	
	No. of mother rhizomes plant^{-1}	No. of primary rhizomes plant^{-1}	No. of secondary rhizomes plant^{-1}	Fresh rhizomes yield plant^{-1} (g)	Fresh rhizomes yield (q ha^{-1})	Essential oil content (%)	Curcumin content (%)
(45 x 20 cm)	2.17	7.33	11.56	272.87	239.86	3.92	4.40
(45 x 25 cm)	2.28	8.18	13.75	288.80	226.90	4.10	5.07
(45 x 30 cm)	2.37	8.93	15.68	311.61	213.29	4.13	5.49
S.Em ±	0.01	0.07	0.14	1.43	0.98	0.04	0.05
C.D. at 5%	0.04	0.21	0.41	4.19	2.88	0.12	0.17
V_1 (Suroma)	2.20	7.47	12.58	282.29	200.83	4.15	4.43
V_2 (Sonali)	2.35	8.83	14.68	300.86	242.94	4.18	5.47
V_3 (Ranga-3)	2.27	8.15	13.72	290.13	236.28	3.85	5.06
S.Em ±	0.01	0.07	0.14	1.43	0.98	0.04	0.05
C.D. at 5%	0.04	0.21	0.41	4.19	2.88	0.12	0.17

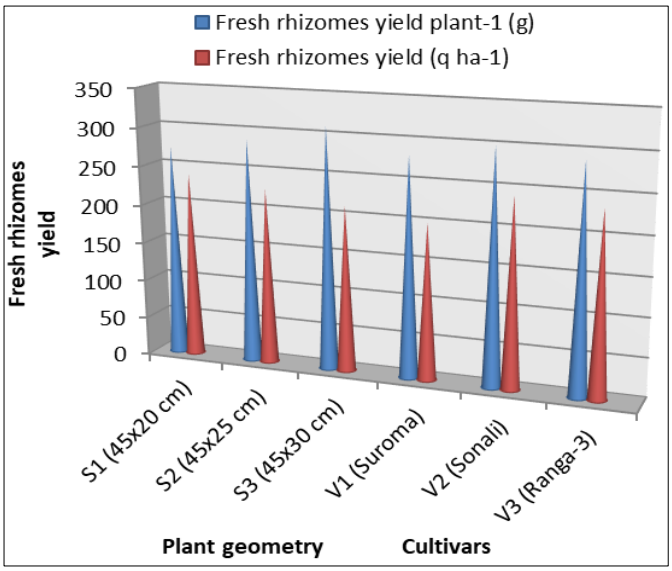

Fig 1: Effect of plant of geometry and cultivars on fresh rhizomes yield

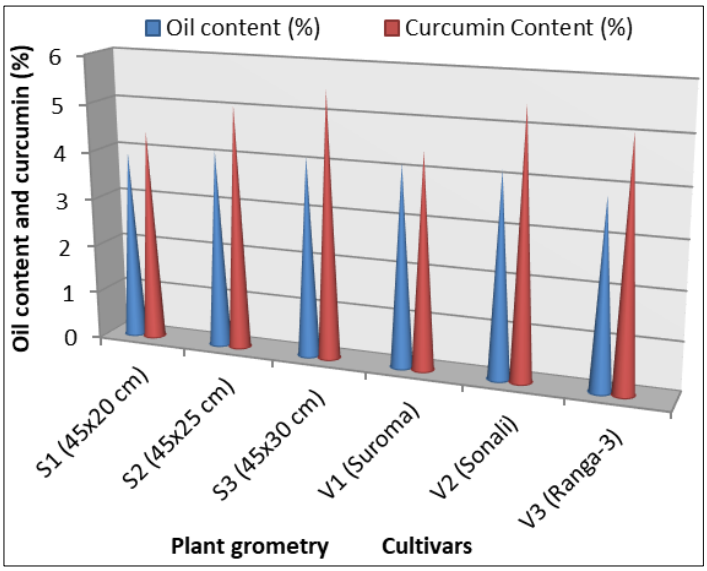

Fig 2: Effect of plant geometry and cultivars on oil content (%) and curcumin (%)

Conclusion

On the basis of one year research it could be concluded that in different plant geometry levels S_3 (45 x 30 cm) was significantly higher in terms of growth and quality of turmeric. However, yield potential can be increased by S_1 (45 x 20 cm) as compared with other plant geometry. In case of cultivars, Cultivar V_2 (Sonali) performed well in growth, yield and quality of turmeric as compared with other cultivars.

Acknowledgments

We are thankful to the Department of Plantation, Spices, Medicinal and Aromatic Crop, RVSKVV- KNK College of Horticulture, Mandsaur (M.P.) for providing lab facilities for the analysis and with thanks for the research farm of Herbal Garden, KNK College of Horticulture, Mandsaur (M.P.) for conduct of experiments. Thanks to my advisory members and other scientist for their valuable time for data analysis.

References

1. Anburani A. Influences of off-season land management of maximizing yield and quality of (*Curcuma longa* L.) cultivars. Journal of Phytology. 2018;10:33-36.
2. Anonymous. Official Analytical Methods. 2nd Edn. American spice Trade Association. 1968;38:9-10.
3. Anonymous. Annual report, NHB Indian Horticulture Data Base, 2018-19.
4. Bahadur MM, Azad AKM, Hakim MA, Hossain SMM, Sikder SP. Effect of different spacing and potassium levels on the growth and yield of turmeric var. Sinduri. Pakistan Journal of Biological Sciences. 2000;3(4):593-595.
5. Bhadouria RS, Singh TK, Haldar A. Effect of interaction on various planting methods and spacing on growth and yield of turmeric (*Curcuma longa* L.). Plant Archives. 2014;14(2):1047-1049.
6. Kumar B, Gill BS. Growth, yield and quality of turmeric (*Curcuma longa* L.) as influenced by planting method, plant density and planting material. Journal of Spices and Aromatic Crops. 2010;19(1-2):42-49.
7. Mariam A. Evaluation of turmeric (*Curcuma longa* L.) genotypes for growth, yield and quality under rainfed condition of Arunachal Pradesh, India. International Journal of Current Microbiology and Applied Sciences. 2019;8(9):619-626.
8. Naruka IS. Note on effect of different row spacing on the growth of garlic (*Allium sativum* L.). Current Agriculture. 2002;24(1-2):137-138.
9. Nautiyal N, Tiwari D, Upadhyay S, Chauhan RS. Effect of nitrogen levels and plant spacing on growth and yield of turmeric. International Journal of Applied and Pure Science Agriculture. 2016;2(10):184-192.
10. Pandey DK, Mishra HR. Effect of various doses of nitrogen and spacing on growth and yield of turmeric (*Curcuma longa* L.) cv. Meduka. Vegetable Science. 2009;36(1):122-123.
11. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. Indian Council of Agriculture Research, New Delhi-108, 1984.
12. Rai SK, Rai KK, Pandey N, Kumari A, Tripathi D, Rai SP. Varietal performance of turmeric (*Curcuma longa* L.) with special reference to curcumin. Vegetable Science, 2016;43(1):36-43.
13. Salimath S, Venkatesha J, Kulkarni S, Shetty GR. Evaluation of turmeric (*Curcuma longa* L.) cultivars for growth and yield in southern dry zone of Karnataka. Advance Research Journal of Crop Improvement. 2014;5(2):162-165.
14. Singh BK, Verma VK. Varieties and planting dates affect the growth, yield and quality of turmeric (*Curcuma longa* L.) in mild-tropical environment. Vegetable Science. 2013;40(1):40-44.
15. Singh J, Malik YS, Nehra BK, Partap PS. Effect of size of seed rhizomes and plant spacing on growth and yield of turmeric (*Curcuma longa* L.). Haryana Journal of Horticulture Sciences. 2000;29(3&4):258-260.