The Pharma Innovation Journal 2023; 12(3): 2954-2957

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(3): 2954-2957

www.thepharmajournal.com
Received: 14-12-2022
Accepted: 23-01-2023

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Effect of water soluble fertilizers on flowering parameters of bush pepper (*Piper nigrum* L.) under agro-climatic conditions of Konkan region of Maharashtra

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Abstract
The present investigation entitled "effect of soluble fertilizers on flowering parameters of bush pepper (*Piper nigrum* L.) under agro-climatic conditions of Konkan region of Maharashtra" was carried out at College of Horticulture, Dapoli, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli. Dist. Ratnagiri (Maharashtra) during 2020-21 and 2021- 2022. The experiment was laid out in randomized block design with seven treatments and four replications. At 720 days after planting maximum number of new spikes per plant were recorded in treatment T_5 i.e. 194.73. At the end of the 2nd year maximum number of berries per spike (85.25) and fresh berry weight per spike (15.30 g) were observed in treatment T_5.

Keywords: Sozuble fertilizers, flowering, bush pepper

Introduction
Black pepper is native of South India. It is a flowering vine in the family piperaceae, cultivated for its berries which are usually dried and used as a spice. Bush pepper is the lateral fruiting branch rooted and grown in pots or in field and are bushy in appearance, starts flowering from the same year of planting and gave yield throughout the year. The cultivation of bush pepper directly in field and also under protected environment is gaining popularity in the district of Konkan region of Maharashtra comprising Sindhudurg, Ratnagiri, Thane, Palghar and Raigad districts. On an average, about 500-1000 ha. Area of Konkan region is occupied with bush pepper (Sharon *et al.*, 2019) [12]. In Konkan region of Maharashtra, the black pepper variety Panniyur-1which generally grown as bush pepper at a spacing of 1×1m under 50% shade net or using poly-house under protected cultivation. Water soluble fertilizers provide an optimal solution to increase the agricultural yields. WSFs are extremely convenient to use as they are available premixed with salts and can be simply sprayed on plants. Being water soluble, these fertilizers are the ideal solution for feeding the necessary amounts of macro and micro nutrients to growing crops. This also makes them cost-effective and eliminates the additional cost of buying in bulk, a major hindrance with traditional fertilizers. (Suvarna and Singh, 2021) [13]. Use of water soluble fertilizers also reduced the chances of wastage of nutrients by leaching or by fixation and making them unavailable to crops. High yield of pepper is urgently needed to meet the increasing population and growing demand for food. One of the main problem faced by the pepper farmers is the high cost of production due to increasing trend of using inorganic fertilizers. The problem is complex because black pepper is a high nutrient demanding crop. Bush Pepper is a surface feeder crop and as it flowers throughout the year. Keeping in view this experiment was conducted to study effect of water soluble fertilizers on flowering parameters of bush pepper.

Material and Methods
The experiment was conducted at College of Horticulture, Dapoli, Dist. Ratnagiri (MS) during the year 2020-21 and 2021-22. The healthy, pest and disease free three months old rooted cuttings of variety 'Panniyur-1' planted in polybags were used for planting for this experiment. The three grades of water-soluble fertilizers like urea, 19:19:19 and 00:00:50 were used. The recommended dose of straight fertilizers like urea, single super phosphate and muriate of potash were used as control.

Bush pepper is small bush grown either in field or pots with yield of 300-500g per plant per year. A fertilizer dose of 25:10:35g NPK per plant per year was considered as recommended dose i.e. ¼ of the vine black pepper plant. From treatment T_1 to T_6 water soluble fertilizers were applied by drenching 100 ml solution to each plant at weekly interval. 52 drenching were done in each year. For treatment T_7 recommended fertilizers were applied in August and January months. All the treatments were supplied with FYM @ 5kg/bush/year + *Trichoderma harzianum* @ 50 g / bush/ year (Devasahayam *et al.*, 2015) [2] in equal split doses twice in a year. The field experiment was laid out in a randomized block design (RBD) comprising of seven treatments with four replications. i.e., T_1 .25% of the RDF through soluble fertilizers at weekly interval, T_2-50% of the RDF through soluble fertilizers at weekly interval T_3-75% of the RDF through soluble fertilizers at weekly interval, T_4-100% of the RDF through soluble fertilizers at weekly interval, T_5-125% of the recommended dose of fertilizer through soluble fertilizers at weekly interval, T_6-150% of the RDF through soluble fertilizers at weekly interval, T_7- Control - 100% of the RDF through straight fertilizers in two equal split doses in a year. (25:10:35g NPK per bush per year).

Though bush pepper is a perennial crop and flowers continuously throughout the year the observation regarding new spikes per plant, days required for harvesting, number of berries per spike, fresh berry weight per spike was recorded as per the methodology given below,

For recording number of new spikes per plant 5 plants from each treatments and replications were tagged and number of spikes per plant was counted per plant at 60 days interval and the total numbers of spikes per plant at 360 and 720 days after planting and also cumulative total of two years was presented in table 1 and depicted in Fig. 1.

To record days required for harvesting just initiated 5 spikes from each treatment and replications were tagged and days required for harvesting during both years was recorded. After harvesting five spikes from each treatment and replication were randomly selected and number of berries per spike and fresh berry weight per spike were recorded. The observations recorded regarding above flowering parameters are presented in Table 2.

The data obtained in the present investigation was statistically analyzed by the method suggested by Panse and Sukhatme (1995) [10]. The standard error of mean (S.E) was worked out and the critical difference (C.D.) at 5 per cent was calculated wherever the results were found significant.

Table 1: Effect water soluble fertilizers on number of new spikes per plant in bush pepper at 360 and 720 days after planting

Treatments	Number of new spikes/plant		
	360 DAP	720 DAP	Cumulative Total
T_1	40.70	51.35	92.04
T_2	54.03	67.05	120.82
T_3	64.10	77.35	141.45
T_4	73.60	85.15	158.74
T_5	90.23	104.50	194.73
T_6	45.28	55.85	101.12
T_7	43.55	52.95	96.49
S.Em±	3.07	1.91	3.69
CD at 5%	4.34	5.53	10.71

T_1	25% of RDF	T_2	50% of RDF	T_3	75% of RDF
T_4	100% of RDF	T_5	125% of RDF	T_6	150% of RDF
T_7	Control- (100% RDF) 25:10:35 g NPK/bush/year (54:63:58 g Urea:SSP:MOP) applied through straight fertilizer in two equal split doses in a year (August and January)				

RDF – Recommended dose of fertilizer

Table 2: Effect water soluble fertilizers on days for harvesting, number of berries per spike, fresh berry weight per spike at harvesting stage

	Days for harvesting		Number of berries/spike		Fresh berry weight/spike (g)	
Treatments	1st year	2nd year	1st year	2nd year	1st year	2nd year
T_1	275.35	270.35	47.25	50.25	6.90	6.30
T_2	249.65	247.20	59.75	68.50	9.38	9.70
T_3	244.30	240.55	66.75	73.00	11.70	12.60
T_4	239.55	237.25	72.50	80.75	12.48	13.28
T_5	235.10	232.85	80.00	85.25	14.00	15.30
T_6	268.70	264.50	69.00	73.75	10.65	11.18
T_7	272.75	270.60	55.50	63.50	7.50	8.48
S.Em±	8.57	7.42	2.44	3.10	0.28	0.48
CD AT 5%	24.87	21.53	7.07	9.00	0.82	1.39

T_1	25% of RDF	T_2	50% of RDF	T_3	75% of RDF
T_4	100% of RDF	T_5	125% of RDF	T_6	150% of RDF
T_7	Control- (100% RDF) 25:10:35 g NPK/bush/year (54:63:58 g Urea:SSP:MOP) applied through straight fertilizer in two equal split doses in a year (August and January)				

RDF – Recommended dose of fertilizer

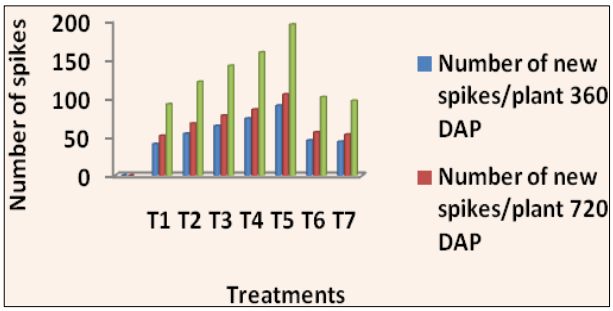

Fig 1: Effect water soluble fertilizers on number new spikes per plant in bush pepper

Result and Discussion

Number of new spikes/plant

The data pertaining to effect of water soluble fertilizers on number of new spikes per plant was presented in Table 1 and depicted in Fig.1. Data presented in Table 1 showed that at 360 and 720 days after planting maximum numbers of new spikes per plant was recorded by the treatment T_5 (125 per cent of RDF through water soluble fertilizers) i.e., 90.23 and 104.50 respectively which was statistically superior over rest of the treatments whereas, minimum number of spikes per plant was recorded by the treatment T_1 (40.70 and 51.35 respectively) where 25 per cent of RDF applied through water soluble fertilizers which was at par with treatment T_7 (43.55 and 52.95 respectively). Cumulative total of new spikes per plant presented in Table 1 showed that maximum number of spikes per plant was recorded in treatment T_5 (194.72) which were statistically superior over rest of the treatments. The minimum number of new spikes per plant was recorded by the treatment T_1 (92.04) i.e. application of 25 per cent of recommended dose of fertilizer through water soluble fertilizers. Which were at par with treatments T_7 (96.49) and T_6 (101.12). The increased in number of new spikes might be due to an optimum level of synthesis of cytokynin at high level of nitrogen and phosphorous resulting in a favorable sink to produce greater number of spikes, which would have led to setting of more number of berries per plant. Further soluble fertilizer application might have increased the number of spikes in two ways. i) By increasing the number of branches and ii) Increasing shoot growth and number of secondary branches and hence the ultimate increase the size of plant thereby, increasing the number of potential sites where spikes could develop. These results are in line with those obtained by Nagaraja (2002) [8] in long pepper, Itoo and Manivannan (2004) [4] in tomato and Karpakam *et al.* (2004) [5] in brinjal.

Days required for harvesting

Data presented in table 2 showed that during both the years of experiment minimum days required for harvesting was recorded by treatment T_5 (125% of recommended fertilizer dose through WSF) i.e., 235.10 days and 232.85 days, respectively which was significantly superior over rest of the treatments. The maximum days required for harvesting was seen when 25 per cent RDF applied through WSF at weekly interval (T_1) i.e., 275.35 days and 270.35 days, respectively which was at par on treatment T_7 (272.75 days and 270.60 days, respectively). The minimum days required for harvesting might be due to gradual increase in NPK levels which reduced the days taken to harvesting to a certain limit and vice versa. The present findings closely agree with those of Natarajan (1995) [9], Naeem *et al.* (2002) [7] and Chapagain and Weisman (2004) [1] in tomato and Pratibha Singh *et al.* (2021) [11] in mustard.

Flowering parameters

Data presented in Table 2 showed that the treatment T_5 recorded maximum number of berries per spike (80.00 and 85.25 respectively), fresh berry weight per spike (14.00 and 15.30g respectively), during 1st and 2nd year of the experiment. During 2nd year the minimum number of berries per spike (50.25) was recorded by T_1 (plants supplied with 25% of RDF through WSF), whereas, minimum fresh berry weight per spike was recorded in treatment T_1 (6.30g). Maximum number of berries per spike in treatment T_5 might be due to uniform and continuous supply of nutrients through water soluble fertilizers which in turn leads to maximum plant growth in terms of branches, number of leaves which leads to increase in yield. Significant variation in the number of berries per spike was noticed among the inorganic fertilizers when applied quarterly split showed maximum number of berries per spike in bush pepper. These results are in accordance with Madhura Devdas (1997) [6] and Farhana (2018) [3] in bush pepper. The effects on growth components were highly pronounced with an increase in the levels of nitrogen resulting in translocation of sufficient food material for berry development. Similar findings were reported by Ughade and Mahadkar (2015) [14] in brinjal and Xiukang and Yingying (2016) [15] in tomato.

Conclusion

Thus, from the present investigation it is concluded that application of 125 per cent of recommended dose of fertilizer i.e. treatment T_5 (31.25:12.50:43.75 g NPK/plant/year) through water soluble fertilizer found to be optimum for production of maximum number of spikes and berries.

Acknowledgment

The authors are grateful to The Associate Dean, College of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli for providing all the facilities during the period of research work.

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