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Effect of organic source of fertilizers along with inorganic on growth, yield and quality of Chillies (*Capsicum annum* L) var PKM 1

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Abstract
The present investigation was aimed at determining the effect of combined combination of biofertilizers along with chemical fertilizers application on growth and yield parameters of Chilli plant. An experiment was conducted at Horticultural College and Research Institute, Periyakulam in the year 2017 Rabi season. The trial was laid out in a Randomized Block Design (RBD) including nine set of treatments with three replication to evaluate the effect of inorganic fertilizers like that N, P and K (75% and 100% prescribed dosage) with organic fertilizers including Azospirillum, Phosphobacteria, potash mobilizer, (each 1 lit/acre) *VAM* (5 kg/acre) and humic acid (3 lit/acre) as soil and foliar application along with control. PKM 1 variety Chilli was taken as a test crop. The seedlings were transferred to the main field and inorganic fertilizers (N, P and K) were applied as per the treatment schedule. The organic fertilizer treatment was imposed at 15 days interval three times on the standing crop with varying dosages. The treatment T_8 (75% RCF + Biofertilizers (Azospirillum + Phosphobacteria + Potash mobilizer + VAM)+ Humic acid Liquid as soil application) was recorded maximum in plant height of 50.2,70.2 and 79.5 cm respectively on 30,60 and 90 days after planting, average number of fruits per plant (174.09), average weight of fruits per plant (828g), yield (30.5 t/ha), Capsaicin content (0.69%) followed by T_6 (RCF + Biofertilizers – (Azospirillum + Phosphobacteria + Potash mobilizer + VAM + Humic plus Liquid as soil application) while the control T_1 recorded lowest.

Keywords: Azospirillum, phosphobacteria, potash mobilizer, *vam*, nitrogen, phosphorus and potassium, RCF- recommended chemical fertilizer

Introduction
Chilli is one of the most important spices of India and is used in bulk quantities of both in fresh as well as dried forms. Important cultivated species of chilli are *Capsicum annum*, *Capsicum frutescence* and *Capsicum chinense*. Chilli (*Capsicum annum*) belongs to family solanecae. India is a leading country in production of chilli in the world, present area under chilli cultivation is about (0.79 million ha) with a production of (1.2 million tonnes) and productivity of about (1.5 t/ha). Active principle for pungency is capsaicin (N-vanilly-8-methyl-69(c) noeamide). The principle colouring pigment is 'capsanthin'.

In India, about 28 million tonnes (mt) of plant nutrients (nitrogen, phosphorus and potash) are removed by field crops per year. No estimates are available in case of nutrients removed by horticulture crops per year. If these too are included, the quantum of nutrient removal would be much higher. No single source of plant nutrients including fertilizers, organic manures, compost, FYM, biofertilizer, green manure is capable to satisfy the crop needs.(N.R. Hemalatha, 2006) [7] Moreover, it has been well established that when nutrients are supplied through inorganic as well as organic forms, the crop yield and crop quality improved significantly.

Biofertilizers enhance availability of nutrients to plants. Azospirillum is considered to be an associative symbiotic bacterium because it lives in close association with the root system of plants. Azospirillum inoculation helps the plants in better vegetative growth and also saves nitrogenous fertilizers upto 25 to 30 per cent. Azospirillum fix nitrogen through an enzyme nitrogenase and also produce growth hormones IAA, GA and Cytokinin (Hubbel *et al.*, 1979) [8] and (Govindan and Nair, 1986) [6]. Phosphotika (phosphatic biofertilizer) solubilize fixed phosphorus already in the soil and make it available to plants. Among the various factors responsible for low production of chilli, nutrition is of prime importance. The chemical fertilizer are not ecofriendly but also costly. The use of inorganic fertilizer has come to level of

causing a concern to environment and human health. (K.K. Bade *et al.,* 2017) [3]. Hence it has become essential to adopt a strategy of organic manures, green manures, biofertilizers, vermicompost etc.

Organic manures and biofertilizers are one of the alternative renewable sources of nutrient supply. Organic manure not only regularly supply macro, micro, and secondary nutrient, but also improve physical, chemical and biological properties of soil. Organic manures are slow releasing, hence are less prone to loss than inorganic fertilizers, hence soil, water and air pollution can be reduced. (Biswanath Talukder, 2007) [4]. This necessitates to find out the new avenue for reducing the use of inorganic fertilizers. In chilli crop, biofertilizers, Azotobacter, Azospirillum are known to fix a substantial amount of atmospheric nitrogen and Phosphate solubilising bacteria (PSB), Vasicular arbuscular mycorrhizae *(VAM)* make more available phosphate in soil, supplied to the crop enhance the fertilizer use efficiency, soil fertility status and ensures partial savings of fertilizers which in terns reduce the cost of cultivation. (Ghoname, A. and Shafeek, M.R. 2005) [5].

Materials and Methods

Field experiment was conducted at western block of Horticultural College and Research Institute, Periyakulam. The PKM 1 variety chilli was taken as a test crop. Five types of bio fertilizers and organic amnure like as Azospirillium, Phosphobacteria, Potash mobilizer, VAM, and Humic acid, were included along with the recommended dose of chemical fertilizer (75:100:50 N, P and K kg/ha) were tested along with control in a Randomized Block Design with three replications. The data were subjected to statically analysis as suggested (Panse and Sukhatme 1985) [10].

Treatment details

T_1- Recommended Chemical Fertilizer (RDF)

T_2- Biofertilizers – (Azospirillum + Phosphobacteria + Potash mobilizer + *VAM*)

T_3 -RCF + Biofertilizers – (Azospirillum + Phosphobacteria + Potash mobilize*r* + *VAM*)

T_4 - RCF + Humic acid Liquid as soil application

T_5 - RCF + Humic acid Liquid as foliar application

T_6 - RCF + Biofertilizers – (Azospirillum + Phosphobacteria + Potash mobilizer + *VAM*) + Humic acid Liquid as soil application

T_7 - RCF + Biofertilizers – (Azospirillum + Phosphobacteria + Potash mobilizer + *VAM*) + Humic acid Liquid as Foliar application

T_8 – 75% RCF + Biofertilizers – (Azospirillum + Phosphobacteria + Potash mobilizer + *VAM*) + Humic acid Liquid as soil application

T_9 - 75% RCF + Biofertilizers – (Azospirillum + Phosphobacteria + Potash mobilizer + *VAM*) + Humic acid Liquid as Foliar application

The recommended dose of inorganic fertilizers were applied T_1 to T_7 treatments and T_8 and T_9 treatments were 75% recommended dose of fertilizers was applied. Biofertilizers was applied 15 days interval for 3 times. Observations was taken on vegetative parameters like plant height (30,60 and 90 days), days to 50% flowering, yield parameters like, number of fruits per plant, average weight of fruits per plant, yield tonnes /ha, biochemical parameters like capsaicin(%) were recorded.

Results and Discussion

Growth parameters

The results indicated significant differences among the kinds of biofertilizers and their combination with inorganic fertilizers. The plant height and days to 50% flowering considered being an important factor to judge the vigour of plant. It was found increased to a significant level with the application of treatments. The data on growth parameters revealed that the treatment T_8 registered highest plant height of 50.2,70.2 and 79.5cm respectively at 30,60 and 90 days after planting followed by the treatment T_6(RCF + BF + Humi Plus Liquid as soil application). Sreenivasa (1992) [11] also reported that, the growth of chilli increased because the P solubilizing bacteria increased the amount of P and the mycorrhizas increased P uptake to the plants thereby facilitating synergistic effect among them.While the treatment T_5 and T_7 recorded on par values. The treatment control recorded the lowest value of 36.5,56.5 and 72.4 cm respectively.

As regard to days to 50% flowering the same treatment has taken minimum number of days for 50% flowering (31.0 days) and the control as taken longer days for 50% flowering of 40 days. (Table. 1). Early flowering in case of biofertilizer application along with inorganic phosphate and humic acid might be due to availability of balanced nutrient and release of growth promoting substances which helps to produce flower of earlier.Higher production of auxin and growth substances by humic acid at early phases of growth could have induced the production of lateral branches and plant height. (Azad, A.K. 2000.) [1] Biofertilizers and combination effect produced highest plant growth as suggested by (Ghoname, A. and Shafeek, M.R. 2005) [5].

Table 1: Effect of combined application of organic and inorganic fertilizer on growth parameter of Chilli cv. PKM 1

Treatments	Plant height (cm)			50% flowering (days)
	30 Days	60 Days	90 Days	
T_1	36.5	56.5	72.4	40.0
T_2	38.2	58.4	74.6	38.9
T_3	41.3	60.8	76.3	36.9
T_4	44.6	52.4	76.0	35.2
T_5	46.7	64.3	77.9	34.9
T_6	48.1	68.6	79.1	32.0
T_7	47.5	69.3	78.9	33.3
T_8	50.2	70.2	79.5	31.0
T_9	49.4	69.4	78.2	32.6
SE.d	0.31	0.43	0.12	0.35
CD(P=0.05)	0.74	0.89	0.34	0.96

Yield and quality parameters

The highest yield was recorded with the application of T_8 - 75% RCF + Biofertilizers – (Azospirillum + Phosphobacteria + Potash mobilizer + VAM) + Humic acid Liquid as soil application (30.5 tonnes/ha) followed by T_6 of 29.8 tonnes/ha. High yield contributing characters like number of fruits per plant (174.09), average fruit weight per plant (828g) followed by T_6- RCF + Biofertilizers – (Azospirillum + Phosphobacteria + Potash mobilizer + VAM) + Humic acid Liquid as soil application recorded the next higher values while control recorded lower yield of 22.0 tonnes/ha, average number of fruits per plant (122.88) and average weight of fruits per plant (584 g). (Table.2). (Amburani and Manivannan, 2002) [2] reported that, the highest number of fruits in brinjal recorded when plants were treated with FYM @ 25 t/ha along with 100% NPK and biofertilizers. The

combined effects increase shelf life of fruits, increased the nutrients availability. The same result which was examined by A balanced use of organic and inorganic fertilizers could enhance soil chemical, physical, and biological properties as well as rate of nutrient turn over within the soil-plant system and increased yield and quality of fruits. Azospirillum fixes the atmospheric nitrogen in the soil enhances the production of phyto hormone like substances and increased uptake of nutrients such as phosphorus and potassium. The biological activity of the microorganisms would have helped the soil status to become a ready to serve zone for essential nutrients to plant's root system (Subramanian and Vijayakumar, 2001) [12].

Quality parameters

Application of 75% RCF along with Humic acid as soil application recorded higher capsaicin content (0.69%), (Table 2.) followed by T_6 while control T_1 recorded lower capsaicin with value of 0.42%.An increase in total capsaicin content with 'N' application was also reported by (Majmudar *et al.* 2000) [9] in chilli.

Table 2: Effect of combined application of organic and inorganic fertilizer on yield and quality parameter of chilli cv. PKM 1

Treatments	Average Number of fruits per plot	Average weight of fruits per plot (g)	Yield tonnes/ha	Capsaicin content (%)
T_1	122.88	584	22.0	0.42
T_2	125.94	604	24.0	0.48
T_3	127.15	683	25.0	0.49
T_4	135.56	596	26.2	0.47
T_5	144.82	740	26.1	0.50
T_6	172.62	810	29.8	0.62
T_7	162.00	642	26.5	0.58
T_8	174.09	828	30.5	0.69
T_9	165.70	654	27.0	0.61
SE.d	0.84	8.42	0.35	0.02
CD(P=0.05)	1.64	17.62	0.64	0.05

Conclusion

Application of 75% recommended chemical fertilizer (75:100:50 N, P and K kg/ha) along with biofertilizer like Azospirillum, Phosphobacteria, potash mobilizer (1 lit/ acre) + VAM (5 kg/acre) along with humic acid (3 lit/acre) as soil application recorded higher yield and quality of chilli crop. The overall result revealed that 75% inorganic fertilizers combined with organic fertilizers increased number of fruits, weight of fruits and yield, compared to control and the percentage increase in yield was 38% over control.

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