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RESEARCH ARTICLE

EFFECT OF ORGANIC AND INORGANIC INPUTS ON FLOWERING AND YIELD CHARACTERS OF BITTER GOURD (*MOMORDICA CHARANTIA* L.) ECOTYPE 'MITHIPAGAL' UNDER RICE FALLOW CONDITION

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ABSTRACT

Studies on "Effect of organic and inorganic inputs on flowering and yield characters of bitter gourd (*momordica charantia* l.) ecotype 'mithipagal' in the rice fallow of cauvery delta region" was undertaken with the organic and inorganic nutrients along with biofertilizers and panchakavya foliar spray. Three different organic manures in different levels such as FYM (12.5, 25 and 37.5 t ha^{-1}), vermicompost (1.25, 2.5 and 3.75 t ha^{-1}) and pressmud (12.5, 25 and 37.5 t ha^{-1}) along with the three levels of inorganic nutrients *viz.,* 100 per cent recommended dose of fertilizers (60:30:30 kg NPK ha^{-1}), 75 per cent (45:22.5:22.5 kg ha^{-1}) and 50 per cent (30:15:15 kg NPK ha^{-1}) and biofertilizers like Azospirillum and Phosphobacteria each @ 2 kg ha^{-1} along with the foliar application of panchakavya @ 3% at two different schedule viz., two spray on 30 and 60 DAS), and three spray on 25, 50 and 75 DAS) were studied in eleven treatment combinations including a control. This experiment was carried out in randomized block design with three replications. The treatment combination of (T_6) [75% RDF (45:22.5:22.5 kg NPK ha^{-1}) + vermicompost @ 2.5 t ha^{-1} + biofertilizers (Azospirillum + Phosphobacteria each at 2 kg ha^{-1}) + panchakavya @ 3% foliar spray on 30 and 60 DAS)] recorded the highest values in the flowering and yield attributes.The minimum days to first male and female flowering, fruit harvestable maturity and the maximum number of female flowers $plant^{-1}$and the highes values in number of fruits $plant^{-1}$, fruit length(cm), fruit diameter(cm), fruit weight(gm) fruit yield $plant^{-1}$ (1.38 kg) were registered with the treatment (T_6) which was followed by T_9.

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INTRODUCTION

India has a wide range of climate and soils on which a large number of vegetable crops are grown. The nutritive values of vegetables are having great impact on our diet. They are excellent sources of proteins, vitamins, carbohydrates and minerals like calcium and iron. Also, they have noteworthy medicinal values which are used in some traditional medicines. India is producing 93.92 million tonnes of vegetables from 624.5 million hectares enabling to secure second rank in the world next to China (Brij Bala and Sharma, 2006). The following crops like tomato, chilli, okra, cowpea, mung bean, pigeon pea, cucumber and sweet potato and other cucurbits were cultivated under rice fallow condition (Jha and Singh, 1993). Also it was found that the rice fallow vegetables such as rice-watermelon and rice-cucumber as summer crops are having more commercial values (Gummadi Apparao, 1997). Bitter gourd (*Momordica charantia* L.) is one of the most popular vegetable in South East Asia. It is a member of the cucurbitaceae family along with cucumber, watermelon, snake gourd and musk melon. Nowadays, they are having an excellent yield potential under the rice fallow of cauvery delta region in Tamilnadu, India In recent years it has been realized that higher yields ha^{-1} in rice fallow vegetables can be obtained by application of recommended dose of inorganic nutrients combined with the application of organic nutrients sources like FYM, vermicompost, pressmud, biofertilizers and foliar application of panchakavya (Rana, 2004). Farmyard manure plays a vital role in vegetable growing and maintenance of soil health. Also, it has been proved that it enhances the quality aspects and shelf life of vegetables (Singh and Kaloo, 2000). Earthworms are very efficient bioconverters of organic wastes into valuable manures called "vermicompost". It seems to possess an inherent property of activity not only as a fertilizer but also as a mild biocide and hence it can be called as a "ferticide" (Pramoth, 1995). Vermicompost is a rich source of major and minor nutrients to the plants and it can be produced by a simple technology (Singh and Sudharshan, 1995). Regarding the application of biofertilizers in the vegetable production, it has an impact not only on nitrogen fixation, but also produces growth promoting and antifungal substances and releases the unavailable nutrient to plant available forms (Narula *et al*., 1980)

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MATERIALS AND METHODS

The investigation was carried out in the Experimental Farm, Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalainagar which is geographically situated at $11^0 24'$ North latitude and $79^0 44'$ East longitude at an altitude of ±5.97 m above mean sea level in Cuddalore district of Tamilnadu, IndiaThe experiment was carried out in the Experimental Farm, Department of Horticulture, Faculty of Agriculture, Annamalai University to study the effect of INM on the growth and yield of bitter gourd ecotype 'mithipagal' under rice fallow condition. The treatments were randomly arranged in each replication. The field was prepared through conservation (minimum) tillage and divided into plots of 20.0 x 12.5 m dimension. Pits of 30 cm^3 were formed at a spacing of 100 x 75 cm and 4 seeds pit^{-1} were sown. Fifteen days after sowing, thinning was done to maintain optimum plant population. The fixed quantity of organic manures (FYM, vermicompost, pressmud and biofertilizers) were applied as basal dose along with half dose of N and full dose of P and K as per the treatment schedule. The remaining N was applied at 30 and 45 days after sowing. The recommended dose of inorganic fertilizers was adapted based on the standardization of graded levels of N, P and K. Foliar application of panchakavya 3 per cent was sprayed in two schedule (two and three spray) at 30, 60 DAS and 25, 50 and 75 DAS respectively. The control was maintained without any organic manures and inorganic fertilizers. Regular irrigation and uniform cultural practices were adopted for all the treatment plots. In each plot, ten plants were selected at random and tagged for recording the biometric observations like flowering and yield characters.

RESULTS AND DISCUSSION

The findings of the present investigation clearly indicated that there was a significant difference on the growth attributes of bitter gourd. Among the growth attributes, vine length at 60 DAS and final harvest have more effect due to the combined application of inorganic, organic nutrients along with biofertilizers. Among the various treatment combinations 75% recommended dose of inorganic fertilizer (45:22.5:22.5 kg NPK ha^{-1}) along with vermicompost @ 2.5 t ha^{-1} and biofertilizers (Azospirillum + Phosphobacteria each @ 2 kg ha^{-1}) + panchakavya @ 3% foliar spray at 30 and 60 DAS showed the maximumearly flowering than the other treatment combination. The induction of earliness due to the application of organic manure along with inorganic fertilizers might be due to the availability of certain macro and micro nutrients and also the improved physico-chemical and biological properties of soil, which enables plant roots to proliferate and for better utilization of nutrients by the plants. The results are in line with the findings of Singh *et al*. (2004) in tomato. Early vigorous growth noted in treatments with organic manures would have helped to synthesis more cytokinin by these plants which might have helped to the translocation of these synthesized cytokinin as well as high amount of phosphorus through xylem vessels and accumulation of cytokinin and phosphorus in auxillary buds, which favored the plants to produce more number of branches $plant^{-1}$ in cucumber (Karuppaiah and Kathiravan, 2006). The production of more branches $plant^{-1}$ would be the reason for increased number of male and female flowers $plant^{-1}$.

Treatment details

T_1	-	100% Recommended Dose of Fertilizers (60:30:30 kg NPK ha^{-1})
T_2	-	100% Recommended Dose of Fertilizers (60:30:30 kg NPK ha^{-1}) + FarmYard Manure @ 12.5 t ha^{-1}
T_3	-	100% Recommended Dose of Fertilizers (60:30:30 kg NPK ha^{-1}) + vermicompost @ 1.25 t ha^{-1}
T_4	-	100% Recommended Dose of Fertilizers (60:30:30 kg NPK ha^{-1}) + Pressmud @ 12.5 t ha^{-1}
T_5	-	75% Recommended Dose of Fertilizers (45:22.5:22.5 kg NPK ha^{-1}) + Farm Yard Manure @ 25 t ha^{-1} + Biofertilizers (Azospirillum + Phosphobacteria each @ 2 kg ha^{-1}) + Panchakavya @ 3% (2 spray at 30 and 60 DAS)
T_6	-	75% Recommended Dose of Fertilizers (45:22.5:22.5 kg NPK ha^{-1}) + Vermicompost @ 2.5 t ha^{-1} + Biofertilizers (Azospirillum + Phosphobacteria each @ 2 kg ha^{-1}) + Panchakavya @ 3% (2 spray at 30 and 60 DAS)
T_7	-	75% Recommended Dose of Fertilizers (45:22.5:22.5 kg NPK ha^{-1}) + Pressmud @ 25 t ha^{-1} + Biofertilizers (Azospirillum + Phosphobacteria each @ 2 kg ha^{-1}) + Panchakavya @ 3% (2 spray at 30 and 60 DAS)
T_8	-	50% Recommended Dose of Fertilizers (30:15:15 kg NPK ha^{-1}) + Farm Yard Manure @ 37.5 t ha^{-1} + Biofertilizers (Azospirillum + Phosphobacteria each @ 2 kg ha^{-1}) + Panchakavya @ 3% (3 spray at 25, 50 and 75 DAS)
T_9	-	50% Recommended Dose of Fertilizers (30:15:15 kg NPK ha^{-1}) + Vermicompost @ 3.75 t ha^{-1} + Biofertilizers (Azospirillum + Phosphobacteria each @ 2 kg ha^{-1}) + Panchakavya @ 3% (3 spray at 25, 50 and 75 DAS)
T_{10}	-	50% Recommended Dose of Fertilizers (30:15:15 kg NPK ha^{-1}) + Pressmud @ 37.5 t ha^{-1} + Biofertilizers (Azospirillum + Phosphobacteria each @ 2 kg ha^{-1}) + Panchakavya @ 3% (3 spray at 25, 50 and 75 DAS)
T_{11}	-	Control

Table 1. Effect of organic and inorganic inputs on days to first male and female flowering and number female flowers $plant^{-1}$ of bitter gourd ecotype 'mithipagal' under rice fallow condition

Treatments	Days to first male flowering	Days to first female flowering	Number of female flowers $plant^{-1}$
T_1 – 100% RDF	33.76	38.19	35.91
T_2 – 100% RDF + FYM @ 12.5 t ha^{-1}	31.14	35.65	40.57
T_3 – 100% RDF + VC @ 1.25 t ha^{-1}	29.27	33.99	43.75
T_4 – 100% RDF + PM @ 12.5 t ha^{-1}	32.93	37.33	37.25
T_5 – 75% RDF + FYM @ 25 t ha^{-1} + BF @ 2 kg ha^{-1} + PK @ 3% (2 spray)	30.11	34.76	42.41
T_6 – 75% RDF + VC @ 2.5 t ha^{-1} + BF @ 2kg ha^{-1} + PK @ 3% (2 spray)	28.13	33.02	45.52
T_7 – 75% RDF + PM @ 25 t ha^{-1} + BF @ 2kg ha^{-1} + PK @ 3% (2 spray)	31.96	36.41	39.23
T_8 – 50% RDF + FYM @ 37.5 t ha^{-1} + BF @ 2 kg ha^{-1} + PK @ 3% (3 spray)	30.93	35.52	41.08
T_9 – 50% RDF + VC @ 3.75 t ha^{-1} + BF @ 2 kg ha^{-1}+ PK @ 3% (3 spray)	28.95	33.78	44.17
T_{10} – 50%RDF + PM @ 37.5 t ha^{-1} + BF @ 2 kg ha^{-1} + PK @ 3% (3 spray)	32.79	37.19	37.61
T_{11} – Control	34.86	39.36	32.54
SED	0.41	0.37	0.61
CD (p = 0.05)	0.81	0.75	1.32

RDF – Recommended dose of NPK fertilizers (60:30:30 kg ha^{-1}), FYM – Farmyard manure, VC – Vermicompost, PM – Pressmud, BF – Biofertilizers (Azospirillum and Phosphobacteria), PK (2 spray) – Panchakavya foliar spray at 30 and 60 DAS, PK (3 spray) – Panchakavya foliar spray at 25, 50 and 75 DAS

Table 2. Effect of integrated nutrient management on number of fruits plant^{-1} ,Fruit length, fruit diameter, fruit weight (g fruit^{-1}) and fruit yield plant^{-1} of bitter gourd ecotype 'mithipagal' under rice fallow condition

Treatments	Number of fruits plant^{-1}	Fruit length(cm)	Fruit diameter (cm)	Fruit weight (g fruit^{-1})	Fruit yield plant^{-1} (kg)
T_1 – 100% RDF	33.64	2.55	2.58	28.83	0.94
T_2 – 100% RDF + FYM @ 12.5 t ha^{-1}	37.71	3.39	2.80	31.03	1.14
T_3 – 100% RDF + VC @ 1.25 t ha^{-1}	40.56	3.87	2.72	32.59	1.29
T_4 – 100% RDF + PM @ 12.5 t ha^{-1}	34.88	2.88	2.65	29.55	1.01
T_5 – 75% RDF + FYM @ 25 t ha^{-1} + BF @ 2 kg ha^{-1} + PK @ 3% (2 spray)	39.32	3.64	2.87	31.94	1.22
T_6 – 75% RDF + VC @ 2.5 t ha^{-1} + BF @ 2kg ha^{-1} + PK @ 3% (2 spray)	42.32	4.13	2.98	33.46	1.38
T_7 – 75% RDF + PM @ 25 t ha^{-1} + BF @ 2kg ha^{-1} + PK @ 3% (2 spray)	36.48	3.16	2.74	30.39	1.07
T_8 – 50% RDF + FYM @ 37.5 t ha^{-1} + BF @ 2 kg ha^{-1} + PK @ 3% (3 spray)	38.10	3.42	2.83	31.27	1.16
T_9 – 50% RDF + VC @ 3.75 t ha^{-1} + BF @ 2 kg ha^{-1}+ PK @ 3% (3 spray)	41.09	3.91	2.93	32.81	1.31
T_{10} – 50%RDF + PM @ 37.5 t ha^{-1} + BF @ 2 kg ha^{-1} + PK @ 3% (3 spray)	35.24	2.93	2.68	29.74	1.02
T_{11} – Control	30.89	2.24	2.44	28.59	0.85
SED	0.61	0.12	0.02	0.31	0.03
CD (p = 0.05)	1.21	0.21	0.04	0.63	0.05

RDF – Recommended dose of NPK fertilizers (60:30:30 kg ha^{-1}), FYM – Farmyard manure, VC – Vermicompost, PM – Pressmud, BF – Biofertilizers (Azospirillum and Phosphobacteria), PK (2 spray) – Panchakavya foliar spray at 30 and 60 DAS, PK (3 spray) – Panchakavya foliar spray at 25, 50 and 75 DAS

These results are in consonance with the reports of Amirthalingam and Balakrishnan (1988) in cucumber. In this present investigation, the yield attributes such as number of fruits plant^{-1}, fruit weight length, girth, yield plant^{-1} and yield ha^{-1} were recorded as the maximum in the treatment combination of 75% recommended dose of inorganic fertilizer (45:22.5:22.5 kg NPK ha^{-1}) + vermicompost @ 2.5 t + biofertilizers (Azospirillum + Phosphobacteria each @ 2 kg ha^{-1}) + panchakavya @ 3% foliar spray at 30 and 60 DAS and it was followed by the treatment having (50% RDF (30:15:15 kg NPK ha^{-1}) + vermicompost @ 3.75 t + biofertilizers (Azospirillum + Phosphobacteria each @ 2 kg ha^{-1}) + panchakavya @ 3% foliar spray at 25, 50 and 75 DAS. This might be due to the increased nutrient availability from the organic manures especially by the application of vermicompost and panchakavya with inorganic nutrients, might have increased the various endogenous hormonal levels in the plants tissue/ which might be the responsible for enhanced pollen germination and pollen tube growth and this ultimately increased the number of healthy flowers that leads to increased number of fruits plant^{-1}, resulting in the yield maximization. This is in line with the reports of Nanthakumar and Veeraragavathatham (1997) in brinjal.Among all the organic manures, vermicompost showed better results in yield attributing characters like fruit weight, length, diameter and fruit number. These might be due to the highest nutrient content of vermicompost (NPK@ 1.12:0.86:0.80 g kg $^{-1}$) compared to FYM (NPK @ 0.89:0.65:0.35%). It is acted as a good medium for growth and development of microbes in the soil and made the nutrients available for plant uptake and increased yield. These results are in consonance with the findings of Rajagopal and Rao (1974) in cucumber.

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