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Asha V Pillai and Sheela K. R

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RESEARCH ARTICLE

ENHANCEMENT OF YIELD IN BHINDI BY FOLIAR APPLICATION OF ORGANIC LIQUID MANURES

Asha V Pillai* and Sheela K. R

Department of Agronomy, College of Agriculture, Vellayani – 695522

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ABSTRACT

Field experiment was conducted to assess the efficiency of selected organic liquid manures on growth and yield of bhindi. The liquid manures were prepared by soaking composite organic manures in water (1:5 ratio), collecting the extract seven days after soaking and enriching the same with PGPR addition. Among the combinations, the extracts of composite manure prepared by mixing groundnut cake, neem cake and poultry manure (in 1:0.5:0.5 ratio), groundnut cake, vermicompost and poultry manure (in 1:0.5:0.5 ratio), and groundnut cake and poultry manure (in 1:1 ratio) recorded high nitrogen content (0.56-0.78%). Foliar application of these liquid manures as substitute to nitrogen for top dressing in bhindi, to enhance plant height, number of functional leaves per plant, number of fruits per plant, fruit weight fruit yield and chlorophyll content.

INTRODUCTION

Use of foliar formulations is gaining importance in crop production owing to its quick response in plant growth. Foliar feeding of nutrients is a viable supplement to conventional soil application and it entails the application *via* spraying of nutrients to plant leaves and stems and their absorption through those sites. Foliar feeding has proved to be the fastest way of curing nutrient deficiencies and boosting plant performances at specific physiological stages. Foliar feeding has been used to supplement major and minor nutrients, plant hormones, stimulants, and other beneficial substances.

It is effective for fast growing plants by providing an extra boost in growth especially during the peak growth phase (Ismail, 1997). Besides nutrients, organic liquid manures contain several beneficial microbes which help to increase yield, impart resistance to diseases and insect pests, improve drought tolerance and enhance crop quality. Organic liquid fertilization is considered as a viable means for enhancing crop production both in conventional and modern production system. The foliar application of organic liquid manures prepared from the combination of organic manures enhanced crop growth, plant height, number of functional leaves per plant, number of fruits per plant, fruit weight fruit yield and chlorophyll content in bhindi

MATERIALS AND METHODS

Six treatments were used to analyse the crop response study (Three composite organic liquid manures having high nutrient content, urea spray, commercial formulation (*Nutrich Z-* 0.3% conc.) and package of practices recommendations (POP). Composite organic manures were prepared by mixing different proportion of various sources and these composite manures were mixed with five times water and the liquid extract was collected after seven days. These treatments were applied to the crop and analysed the growth characters like plant height, number of functional leaves per plant, number of fruits per plant, fruit weight fruit yield and chlorophyll content in bhindi

T_1 – Ground nut cake +poultry manure (1:1)

T_2 - Ground nut cake + poultry manure +vermi compost (1:0.5:0.5)

T_3 - Ground nut cake +neem cake+ poultry manure (1:0.5:0.5)
T_4 – Urea 2%
T_5 – Commercial formulation (*Nutrich – Z-* 0.3%)
T_6 – Control (POP recommendation of respective crops)

Corresponding author:* **Asha V Pillai
Department of Agronomy, College of Agriculture, Vellayani – 695522

RESULTS AND DISCUSSION

Growth characters

Plant height

The data on plant height of bhindi recorded at different periods is presented in Table 1. The data revealed that the treatments caused significant variation in plant height at different intervals. T_3 recorded maximum plant height at all stages. At 30 DAS, T_3 was followed by T_6, T_5 and T_4 which were on par. The lowest value was registered by T_2. At 60 DAS T_3 registered the highest plant height of 68.05 cm which was followed by T_6 and T_4 which were on par. At 90 and 120 DAS, T_3 was followed by T_6 and the lowest plant height was registered by T_1 (76.00 and 87.15 cm respectively).

Total dry matter production

The results indicated that the different sources of foliar nutrition had significant influence on the total dry matter production. Among the treatments T_3 registered the highest dry matter yield of 5.74 t ha^{-1} and was followed by T_5 and T_2. T_4 registered the lowest dry matter production of 5.30 t ha^{-1}

Chlorophyll content

The highest chlorophyll content was observed in T_3 (29.90 mg g tissue^{-1}) which was significantly superior to all other treatments and was followed by T_5 (25.50 mg g tissue^{-1}) which was on par with T_6 (24.90 mg g tissue^{-1}). The content was the lowest in T_1 (17.91 mg g^{-1} tissue).

Table 1 Effect of foliar nutrition on plant height (cm) and number of functional leaves plant^{-1} at different intervals

Plant height and No. of functional leaves at different intervals								
Treatments	30 DAS		60 DAS		90 DAS		120 DAS	
	Plant height	No. of leaves	Plant height	No. of leaves	Plant height	No. of leaves	Plant height	No. of leaves
T_1	41.21	12.02	61.94	33.77	76.00	36.77	87.15	34.87
T_2	40.01	10.85	63.67	33.44	87.59	36.10	98.55	33.81
T_3	46.34	15.19	68.05	42.20	92.03	45.70	103.63	40.87
T_4	42.02	10.48	63.95	32.38	87.59	35.20	98.54	31.86
T_5	42.27	11.74	63.39	34.29	87.52	37.09	97.50	34.88
T_6	42.72	12.36	65.30	36.00	89.44	39.33	99.89	36.77
SE	0.39	0.21	0.46	0.43	0.48	0.36	0.47	0.20
CD (0.05)	1.201	0.651	1.404	1.316	1.475	1.11	1.416	0.63

Table 2 Effect of foliar nutrition on total drymatter production (t ha^{-1}) and chlorophyll content (mg g^{-1}tissue)

Treatments	Drymatter production	Chlorophyll content
T_1	5.31	17.91
T_2	5.34	22.05
T_3	5.74	29.90
T_4	5.30	21.44
T_5	5.40	25.50
T_6	5.35	24.90
SE	0.003	0.31
CD (0.05)	0.009	0.960

Number of functional leaves plant^{-1}

The data revealed significant variation among treatments in the number of functional leaves plant^{-1} recorded at different periods. At all stages, T_3 was found to be significantly superior to all other treatments. At 30 DAS, T_3 was followed by T_6, T_5 and T_1 which were on par. At 60, 90 and 120 DAS, T_3 was followed by T_6 which was significantly superior to other treatments. T_2 recorded the lowest leaf number at 30 and 60 DAS. At 90 and 120 DAS, T_4 was found to be significantly inferior to other treatments on number of functional leaves plant^{-1}.

The results from the crop response study in bhindi revealed that growth attributes like plant height and functional leaf number at different stages were maximum in the treatment where the topdressing of N was done by the foliar application of liquid manure prepared from the composite manure of groundnut cake, neem cake and poultry manure (1:0.5:0.5 ratio) enriched with PGPR (T_3). Beneficial microorganisms were observed on the phyllosphere of plants two days after foliar treatment with organic foliar liquid manures. The proliferation of these micro organisms due to PGPR addition and their subsequent survival by the nutrients in liquid organic manures might have contributed to the plant growth. Nishana (2005) reported that the soil and foliar application of vermiwash @ 50 ml plant^{-1} resulted in enhanced growth of bhindi.

Yield Attributes and Yield

Number of fruits plant^{-1}

Data on the effect of treatments on number of fruits plant^{-1} is presented in Table 3. The maximum fruit number was registered in T_3 (26.90) which was significantly higher than all other treatments.

Table 3 Effect of foliar nutrition on yield attributes and yield of bhindi

Treatments	No. of fruits plant^{-1}	Weight of fruits plant^{-1}	Yield at each harvest						
			1st harvest	2nd harvest	3rd harvest	4th harvest	5th harvest	6th harvest	Total yield
T_1	20.66	555.83	1.47	1.86	2.13	2.16	2.46	1.21	11.31
T_2	21.08	551.03	1.75	1.94	2.19	2.31	2.48	1.63	12.32
T_3	26.90	685.36	2.51	2.38	2.46	2.92	3.25	2.27	15.80
T_4	21.58	575.13	1.39	1.39	2.14	2.21	2.52	1.75	11.42
T_5	22.58	577.59	1.81	1.87	2.23	2.29	2.46	1.53	12.21
T_6	22.66	581.52	1.41	1.88	2.16	2.22	2.55	1.37	11.61
SE	0.29	4.06	0.027	0.024	0.027	0.015	0.006	0.031	0.045
CD(0.05)	0.877	12.248	0.082	0.073	0.084	0.035	0.020	0.093	0.135

This was followed by T_6 (22.66) which was on par with T_5 (22.58). The lowest fruit number was recorded by T_1 (20.66) which was on par with T_2.

Weight of fruits plant^{-1}

Data showed significant variation among treatments in the weight of fruits plant^{-1}. T_3 recorded the maximum weight of fruits (685.36 g plant^{-1}) which was significantly superior to other treatments. T_3 was followed by T6 (581.52 g plant^{-1}) which was on par with T_4 and T_5.

Yield

The different treatments tried had a significant effect on the yield of bhindi. At all the harvests the highest yield was obtained in T_3 (2.51, 2.38, 2.46, 2.92, 3.25, 2.27 t ha^{-1} respectively). In the first and fourth harvests T_3 was followed by T_5 and T_2 which were on par. However, in second harvest all other treatments except T_4 were on par and followed T_3. In third harvest, T_3 was followed by T_5 which was on par with T_2 and T_6. In fifth and sixth harvests T_3 was followed by T_6 and T_4 respectively. The treatments T_1 and T_5 registered the lowest yield in fifth and sixth harvests. Total yield also showed significant variation among treatments and the highest yield was recorded in T_3 (15.80 t ha^{-1}) which was significantly superior to all other treatments. T_3 was followed by T_2 and T_5 which were on par. The other three treatments *viz;* T_1, T_4 and T_6 were observed to be on par with each other. The enhanced growth parameters contributed to yield by increasing yield attributes namely the fruit number plant^{-1} and fruit weight plant^{-1}. Moreover, T_3 recorded higher chlorophyll content than other treatments.

The high N content of the liquid manure increased the chlorophyll content. Whapham *et al*., (1993) also observed enhanced chlorophyll content in tomato by foliar application of sea weed extract. Increased chlorophyll content might have enhanced the photosynthetic efficiency leading to improvement in yield attributes and yield. The positive influence of yield attributing characters on bhindi yield was observed earlier by Nishana (2005).

CONCLUSIONS

The results of field study revealed that foliar application of organic liquid manure (T_3) as a substitute to top dressed N, enhanced the growth parameters of bhindi like plant height, number of functional leaves per plant and yield attributes like number of fruits per plant, fruit weight chlorophyll content and fruit yield. The addition of PGPR on the liquid manures enhanced the N content by in vitro nitrogen fixation of micro organisms and thus enhancing the crop growth and yield.

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