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(II)

MORINGA OLEIFERA LEAF EXTRACT AS BIOSTIMULANT FOR INCREASING PEA YIELD

The nutritional quality of food raised by organic farming in comparison to conventional farming is a current issue that continues to attract interest and generate discussion. Consumers regard organic foods not only as better, but also a safe, more hygienic, and free of chemical residues and artificial ingredients (Winter and Davis, 2006). Organic fertilizers not only increase physical (porosity, structure and water-holding capacity) and chemical properties of soil but also increase mineral deposition, which is essential for proper development of plants (Galbiattia *et al.*, 2007). Therefore, application of organic fertilizer has received great attention especially among the farmers (Chang *et al.*, 2007). In fact, nutrient management through organic resources is very essential for crops (Kannaiyan, 2000).

Today farmers are well aware about the application of organic fertilizer to improve their crop production as well as farming land (Galbiattia *et al.*, 2007). In order to fill the demand of organic fertilizer, one of such option is use of *Moringa oleifera* leaf extracts (MOLEs) as fertilizer (Davis, 2000). In agriculture and horticulture, use of MOLEs has proved beneficial for the growth and yield (Chang *et al.*, 2007), deeper root development and better seed germination (Kannaiyan, 2000), delay of fruit senescence, and improved plant vigour and yield quality/quantity (Phiri and Mbewe, 2010; Hossain *et al.*, 2012). MOLEs also impart the crops the ability to withstand adverse environmental conditions (Chang *et al.*, 2007).

MOLEs contain major and minor nutrients, amino acids, vitamins, and also cytokinins, auxins, and abscisic acid (ABA) like growth substances (Foidle *et al.*, 2001). This is due to the presence of cytokinin, which makes *Moringa* leaf extract suitable for vegetable crop production (Makkar and Becker, 1996). Cytokinins are commercially available in the form of benzyl amino purine (BAP) or Trans-Zeatin, but their use is much costly. *Moringa* (*Moringa oleifera* L.) is a tree commonly known

as drumstick tree. It is well known for its miraculous nutritional and medicinal properties. Leaves of tree are extremely rich in vitamins (A, B, C), essential minerals (K, Ca, Fe), antioxidants (Ascorbate, Phenolics), proteins and growth hormone zeatin (Foidle *et al.*, 2001). Hence, its leaf extract either prepared in 80% ethanol or in water contains growth-enhancing substances and can be used as natural source of growth promoter (Fuglie, 2000). Plants treated with MOLEs exhibited more pest and disease resistance, vigorous life-span, heavier roots, stems and leaves, bigger fruits, higher sugar levels and an overall 20-35% increase in yield (Makkar and Becker, 1996). Significant increase in yield of different crops with foliar application of MOLEs has been reported (Balbir, 2006). The present study evaluates foliar spray of MOLEs in enhancing growth, yield, and quality of pea in the field.

A field experiment was conducted at Institute of Forest Productivity, Lalgutwa, Ranchi during January to March 2012. Loamy soil of the area had pH in the range of 5.5 to 6.5. Certified seeds of uniform size and colour were used for sowing at a spacing of 6"x 6" in 12'x 4' size beds. Experiment was laid out in a randomized block design with four replications per treatment [0, (Control, water spray) and 12.5%, 25.0%, 50.0% v/v of *Moringa* leaf extract]. Foliar application of leaves mixed with surfactant extract for proper adherence, was given once a week using sprayer beginning from flower bud initiation and stopped when most of the pods matured and were ready for harvesting.

At termination of experiment fresh and dry weight of harvested pea pods and plants were recorded. The data obtained were subjected to statistical analysis, employing analysis of variance (ANOVA), 'F'-test for significance at P = 0.05 and computing LSD values to separate means in different statistical groups using statistical software IBM SPSS version 18.

Significant enhancement of the fresh and dry weight of pea pods was recorded with 12.5% *Moringa*

Table 1 : Effect of *Moringa oleifera* leaf extract (MOLE) on yield of pea pods and plants biomass.

Treatment s (Aqueous leaf extract)	Fresh weight of pea pod (Kg)	Fresh weight of biomass (Kg)	Dry weight of pea pod (Kg)	Dry Weight of biomass (Kg)
Control	1.192 ^a	0.880 ^a	0.373 ^a	0.394 ^a
12.5%	1.810 ^b	1.130 ^b	0.624 ^b	0.590 ^b
25.0	1.220 ^a	0.800 ^a	0.456 ^b	0.301 ^a
50.0	1.142 ^a	0.810 ^a	0.358 ^a	0.412 ^a
LSD _{0.05}	0.237	0.145	0.003	0.009

extract (Treatment 2) (Table 1). Application of 25% *Moringa* extract also resulted in statistically similar response to Treatment-2 for dry weight of pods. The 12.5% MOLE treatment recorded a significant increase in fruit yield i. e. fresh weight 51.84% and dry weight 67.29% as compared to control (Fig.1).

More or less similar trend were observed with treatment-2 providing better fresh and dry weight of plants (fresh weight 28.4% and dry weight 49.74%) compared to control and remaining extract concentrations (Table 1). The increase in pod yield in plants receiving in foliar application of MOLE was probably due to the presence of high endogenous levels of cytokinin-like substances (zeatin, kinetin, etc.) resulting in the increase in size of fruit and number of fruit per plant. Vigorous growth of annual plants reflected in the copious fruit production. Previous studies have revealed the presence of appreciable amounts of cytokinin-like substances in *Moringa oleifera* leaves (Mishra, 2012). Similar results in other crops with application of MOLEs have also been reported by Balbir (2006). Exogenously applied cytokinins in high concentrations results in growth inhibition especially growth of lateral roots (Srivastava, 2002). Overall, fine

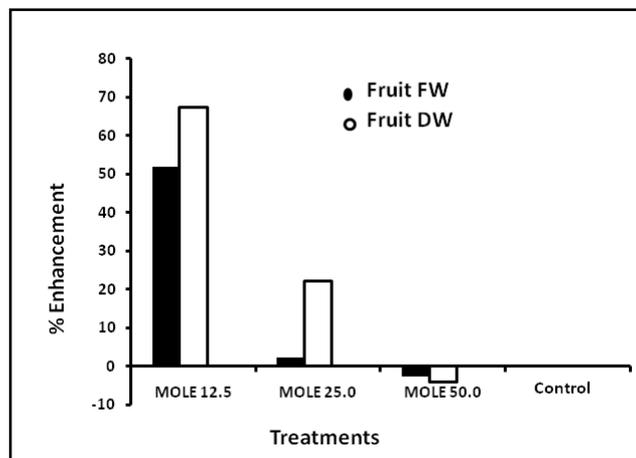


Fig. 1 : Per cent enhancement of pea fruit yield over control

adjustment of cytokinin levels within the plant is needed to achieve the optimal growth of shoots (Gan and Amasino, 1995). Thus, dose standardization of *Moringa* leaf extract is essential. In the present study also it was observed that higher doses of leaf extracts became either supra optimal or inhibitory for fruit yield and plant growth.

Thus, *Moringa oleifera* leaf extracts (12.5% leaf extract + 87.5% water) is suitable for the vegetable growth and the fruit yield.

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Satya Prakash Mishra, Pankaj Singh,
Sanjay Singh, Rameshwar Das and R.S. Prasad

Botany, Silviculture and NWFP Division
Institute of Forest Productivity, Ranchi (Jharkhand)