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Influence of different levels of bio-fertilizers and PGR's on growth attribute and protein content of Mung bean under custard apple based agri-horti system

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ABSTRACT
The experiment was conducted to study the effect of different levels of bio-fertilizers and PGR's on mungbean under custard apple based agri-horti system. The experiment was conducted in a complete randomized block design with different treatments combination viz. Harit Vardan (bio-fertilizer), Bioplantomin (liquid bio-manure), Biovita (organic product), Farm Bahar (polymorphic growth hormones) and Plantgro (multi-micronutrients) which were replicated thrice. These treatments were applied in different doses and method of application of these treatments either in the form of soil treatment or foliar spray. The biometric observations on growth attributes were recorded at an interval of 15 days, that is, 15, 30th and 45th days after sowing and at maturity. By applying Bioplantomin (Liquid bio-manure) at 3.5 l ha^{-1} as foliar spray were found highest in plant height (55.00 cm), number of branch plant^{-1} (4.32), number of trifoliate leaf plant^{-1} (9.4) and total dry matter accumulation plant^{-1} (11.66g). Protein content (25.70%) also found highest by applying (T_6) Bioplantomin while lowest growth attribute viz.- plant height (38.56), number of branch plant^{-1} (2.52), number of trifoliate leaf plant^{-1} (4.66) and total dry matter accumulation plant^{-1} (6.15g) as well as protein(18.97) were obtained with control treatment (T_{13}).
Keywords: Agri-horti System, Custard apple, Growth, Mung bean, Protein.

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INTRODUCTION

Agro forestry system with judicious mixing of crop, tree and grasses meet all basic requirements of mankind and his livestock [1]. Under the different Agroforestry system Fruit tree based agro forestry involves intentional and simultaneous association of annual or perennial crops with perennial fruit-producing trees on the same land unit. Agri-horti system has emerged as a viable option for achieving land cover on one hand and to fulfill the increasing demand of food grain and fodder to human and livestock on the other hand. Tree based cropping system have proved to be very successful in areas receiving less than 1000 mm rainfall with nine months of dry season [2]. The relatively short juvenile (pre-production) phase of fruit trees, high market value of products and the contribution of fruits to household dietary needs, fruit-tree-based agro forestry enjoy high popularity among producers worldwide. Farmers realize the problem of no economic returns in the initial stage of fruit tree orchards till the tree starts bearing fruits. There is ample scope to utilize the introduction of the fruit tree during the initial 5 to 6 years by growing arable crops [3].

Custard apple (*Annona squamosa* L.) is distributed throughout the tropics and is pre-eminently a desert fruit, normally eaten fresh. The vitamin C content is appreciable (35-42 mg100^{-1} g) and slightly higher than the grape fruit. The tree is a good source of firewood, the light yellow sapwood and brownish heartwood are soft, light in weight and weak. Green fruits, seeds and leaves have effective vermicidal and insecticidal properties. Leaves, shoots, bark and roots have been reported to have medicinal properties. Further, studies at Jhansi also revealed that interspaces of custard apple orchards can be exploited by intercropping grain and fodder crops during initial stage of establishment of fruit trees [4].

Pulses are the most important crops of India and are considered as life blood of agriculture because of their unique position in every system of farming. Pulses are also important for sustainable agriculture as

they improve physical, chemical and biological properties of soil and function as mini-nitrogen factory. Indian pulse production has been stuck in between 14 and 15 mt since mid-nineties, resulting in poor consumption (33 g/capita/day) during 2010 [5]. Mungbean (*Vigna radiata* L. Wilczek) is a pulse or food legume crop used primarily as dried seed and occasionally as forage of green pods and seeds for vegetables. It is becoming an important crop, as it is the best alternative to meet the food needs of the large population of developing countries due to its nutritional superiority and nitrogen fixing characters (6). Mungbean can play the major role in national economy of India due to their wider adaptability, easy digestibility, better palatability and higher market price [7-10]. Potential yield of mungbean can be achieved through optimum use of inputs and agronomic practices. It is drought tolerant that can withstand adverse environmental conditions and hence successfully be grown in rain fed areas [11]. It is widely grown in Indian subcontinent as a short duration catch crop between two principal crops [12]. Mungbean, compared with other crops has a better chance of surviving under adverse condition such as poor soil fertility and moisture stress.

Bio-fertilizers and Plant growth regulators (PGR's) are known to improve physiological efficiency including photosynthetic ability of plants and offer a significant role in realizing higher crop yields. Fertilizer is one of the most important factors that affect crop production. Fertilizer recommendation for soils and crops is a dynamic process [13, 14 & 15] and the management of fertilizers is one of the important factors that greatly affect the growth, development and yield of mungbean [16]. Organic nutrients also provide balanced nutrition in addition to enhancing water holding capacity and improving physical, chemical and biological properties (micro-organisms) of soils which assist in better uptake of nutrients. Multi-micronutrients are important supplement for the plant food. It is feasible in open field agriculture and also contain iron and zinc that are often immobilized in the conducting system, enter into the plant system through leaves. Besides, PGR'S also enhance protein and nutrient content (nitrogen, phosphorous and potassium). Hence, there is a need to study the effect of different levels of bio-fertilizers and PGR's on growth attribute and protein content of mung bean under custard apple based agri-horti system to boost up the productivity and protein contents.

MATERIALS AND METHODS

The experiment was carried out in the year 2011-2012, at the Agronomy farm of Rajiv Gandhi South Campus, Brakachha (BHU) Mirzapur which is situated in Vindhyan region of district Mirzapur (25º 10' latitude, 82º 37' longitude and altitude of 427 meters above mean sea level) occupying over an area of more than 1000 ha where variety of crops like agricultural, horticultural, medicinal and aromatic plants are grown. Vindhyan soil comes under rainfed and invariably poor fertility status. This region comes under agro-climatic zone IIIA (semi-arid eastern plain zone). Maximum temperature in summer is as high as 44.65° C and minimum temperature in winter falls below 8.12 °C. The average annual rainfall of locality is 1100 mm, of which nearly 90 per cent is contributed by South West monsoon between July to September. The total rainfall during the crop season 2012-13 was 1207.4 mm; maximum and minimum temperature are 38.7ºC and 16ºC, and relative humidity are 90 and 33 per cent respectively. The experiment was conducted in Randomized Block Design with 13 (thirteen) treatments which were replicated thrice. Recommended intercultural operations were practiced. The biometric observations on growth attributes were recorded at an interval of 15 days, that is, 15,30th and 45th days after sowing and at maturity. Growth attributes that is, plant height, number of trifoliate leaf plant^{-1}, number of branches plant^{-1}, total dry matter accumulation plant^{-1} were measured. For protein content, seed sample from each plot was taken randomly and subjected to chemical analysis by Kjeldahl's method [17]. Available nitrogen percentage was determined through standard wet digestion method. Nitrogen percentage was converted to protein content by multiplying with constant factor (6.25) [18].

Soil analysis

The soil of the experimental field was sandy loam in texture with low drainage. It was acidic in reaction, poor in nitrogen as well as phosphorus and potash.

RESULTS AND DISCUSSION

Influence of different levels of bio-fertilizers and PGR's on growth attribute and protein content of mung bean under custard apple based agri-horti system

Plant height (cm)

Basically, plant height is a genetically controlled character, but several studies indicated that the plant height can either be increased or decreased by the application of synthetic plant growth regulators and biofertilizers. However, in the present investigation significant differences were observed in plant height of mung bean due to application of different treatment combinations (Table 2). Plant height (55.00 cm) was highest when (T_6) Bioplantomin (Liquid bio-manure) was applied at 3.5 l ha^{-1} as foliar spray which

was at par with Plantgro 4.0 gm l^{-1} (T_{12}), Bioplantomin 2.5 l ha^{-1} (T_5) and Farm Bahar 2ml l^{-1} (T_{11}). Lowest plant height (38.56 cm) was obtained in control treatments (T_{13}). The increased growth parameters may be attributed to increased cell division due to sufficient supply of nitrogen and phosphorus by PGR's and biofertilizers. These results are also in conformity with Shukla *et al*. [19], where the application of Triacontanol in soybean was more effective and increased the plant height and such increase was due to increased photosynthetic activity. Similar beneficial effect of growth promoters on plant height has also been reported in soybean by Dashora and Jain (20) and in lentil by Neelam *et al*. [21].

Total dry matter accumulation plant^{-1}

(T_6) Bioplantomin (Liquid bio-manure) was applied at 3.5 l ha^{-1} as foliar spray observed highest dry matter (11.66g) accumulation which was at par with Plantgro 4g l^{-1} (T_{12}), Bioplantomin 2.5 l ha^{-1} (T_5) and Farm Bahar 2ml l^{-1} (T_{11}) due to the beneficial effect of these treatments on leaf development. Control treatment (T_{13}) recorded (6.15g) significantly lowest total dry matter accumulation (Table 2). This could be due to the translocation of stored photo-assimilates towards the development of reproductive organs and senescence. Shah and Prathapsenan [22] reported that application of Cycocel lead to incresase leaf dry weight by 52.7 per cent over control in green gram. Similar result were also been observed by Wasnik and Bagga [23] in chickpea through application of Mepiquat Chloride and Balchandar *et al.* [24] in black gram through the foliar application of molybdenum and boron.

Table 1: Treatment details

Code	Treatments	Quantity	Application
T_1	Harit Vardan (Bio-fertilizer)	3.5kg ha^{-1}	Soil treatment
T_2	Harit Vardan (Bio-fertilizer)	5.5kg ha^{-1}	Soil treatment
T_3	Harit Vardan (Bio-fertilizer)	7.5kg ha^{-1}	Soil treatment
T_4	Bioplantomin (Liquid bio- manure)	1.5 l ha^{-1}	Foliar spray
T_5	Bioplantomin (Liquid bio-manure)	2.5 l ha^{-1}	Foliar spray
T_6	Bioplantomin (Liquid bio-manure)	3.5 l ha^{-1}	Foliar spray
T_7	Biovita (Organic product)	0.4 l ha^{-1}	Foliar spray
T_8	Biovita (Organic product)	0.6 l ha^{-1}	Foliar spray
T_9	Biovita (Organic product)	0.8 l ha^{-1}	Foliar spray
T_{10}	Farm Bahar (Polymorphic Growth Hormones)	2.0ml l^{-1}	Seed Treatment
T_{11}	Farm Bahar (Polymorphic Growth Hormones)	2.0ml l^{-1}	Seed Treatment + Foliar Spray
T_{12}	Plantgro (Multi-micronutrients)	4.0 g l^{-1}	Foliar spray
T_{13}	Control	-	-

Table 2: Influence of different levels of bio-fertilizers and PGR's on plant height, dry matter accumulation, trifoliate leaves plant^{-1} and branches plant^{-1} at harvesting

Treatments	Plant height (cm)	Dry matter accumulation (g)	Number of trifoliate leaf plant^{-1} (No.)	Number of branches plant^{-1} (No.)
T_1	45.24	6.56	5.7	2.65
T_2	47.85	7.37	6.16	3.08
T_3	48.91	8.12	6.83	3.26
T_4	49.32	8.52	7.03	3.34
T_5	54.51	10.23	8.8	4.00
T_6	55.00	11.66	9.4	4.32
T_7	46.22	7.11	5.96	2.90
T_8	48.74	8.01	6.4	3.14
T_9	49.41	8.66	7.4	3.57
T_{10}	50.02	8.84	7.9	3.77
T_{11}	50.95	9.99	8.53	3.98
T_{12}	54.62	11.11	9.03	4.26
T_{13}	38.56	6.15	4.66	2.52
SEm±	0.80	0.22	0.08	0.07
CD (*P*=0.05)	2.35	0.64	0.24	0.21

Table 3: Influence of different levels of bio-fertilizers and PGR's on growth parameters of custard apple based agri-horti system

Tree height (m)		Canopy diameter (m)		Stem girth (cm)		Shading (m)	
At sowing	At crop maturity	At sowing	At crop maturity	At sowing	At crop maturity	At sowing	At crop maturity
2.88	3.62	8.10	8.73	32.78	33.54	2.88	4.72

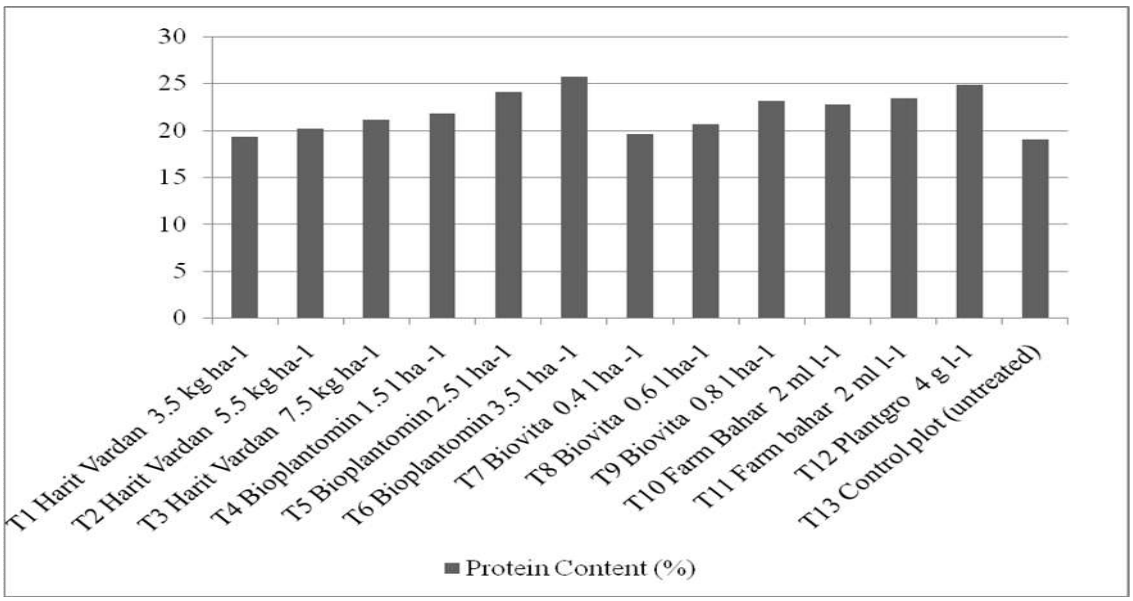

Figure 1: Influence of different levels of bio-fertilizers and PGR's on protein content of mung bean under custard apple based agri-horti system

Number of trifoliate leaf plant^{-1}

In general, leaf is considered as an important functional unit of plant which is factory of photosynthesis and ultimately contributes to the enhancement of yield. The number of leaves were maximum at 40 DAS and declined later due to shedding. In general, the application of various treatments increased the number of leaves over the control. Bioplantomin 3.5 l ha^{-1} (T_6) as foliar spray was found to be more effective (9.4) among all the treatments, while lowest number of trifoliate leaf per plant (4.66) obtained with control treatments (T_{13}) (Table 2). The increase in leaves number due to the application of organic components influences stimulatory effects on cell division and enlargement, protein and nucleic acid synthesis in potato (25). Similarly, penetration of roots to deeper depths, resulting more absorption of water and nutrients influences the leaf number is the function of biofertilizers and PGR's. Finding of Prakash et al. (26) suggested that the application of Chamatkar at 120 ppm increased the number of leaves in black gram. Similar result was also been observed in mulberry by Manian *et al*. [27] through the application of Triacontanol.

Number of Branch plant^{-1}

The application of various treatments increased the number of branches significantly and the increase was more pronounced at higher concentration of the treatments. Bioplantomin 3.5 l ha^{-1} (T_6) recorded higher number of branches per plant (4.32) at all the stages and it was found at par with Plantgro 4g l^{-1} (T_{12}) against minimum (2.52) in control (Table 2).). The increase in the number of branches could be due to the suppression of apical dominance as a result of increase in the auxin activity due to the application of growth retardants, thereby diverting the polar transport of auxin towards the basal buds leading to increased branching. Similarly, Mandal *et al.* [28], Ray [29] and Dhaka and Anamika [30] reported that application of Cycocel, Mepiquat Chloride (DPC), phosphatic fertilizers and micronutrients increased the number of branches in green gram, moth bean and broad bean respectively.

Influence of different levels of bio-fertilizers and PGR's on protein content of mung bean under custard apple based agri-horti system

Protein content

The influence to protein content in plant is result of stimulation of bio-chemical interaction of biofertilizers and PGR's with plant biological activity. The protein content was showed significant differences between treatments. Maximum protein content (25.70%) was recorded with Bioplantomin (T_6) which was significantly superior over remaining treatments and in control it was found lowest (18.97%) (figure 1). Enhancement in seed protein content in mungbean due the application of biofertilizers and PGR's which is in accordance with the results of present finding. In the present investigation it may be ascribed to increased nitrogen uptake of leaves due to the application of treatments. Because biofertilizers and PGR's supports phytohormones production which stimulate nutrients absorption as well as photosynthesis process as a result of this protein content increases [31]. Actually the enhanced leaf nitrogen uptake might have increased amino acid synthesis and thereby could have improved the seed protein content via their translocation to seeds. A significant effect of inorganic P

fertilizers and N and P biofertilizers application on seeds/grains protein content has been reported by various workers in different crops, viz. Aslam *et al.* [32] in chick pea, Naeem *et al.* [33] in cassiatora, Singh *et al.* [34] in mungbean and Selvakumar *et al*. [35] in black gram. Similar result were also been obtained by Sritharan *et al.* [36] and Ghai *et al.* [37].

Growth parameters on custard apple

Statistically non significant differences observed in the mentioned growth parameters of custard apple might be due to shorter growth phase of mungbean which could not realized the noticeable changes in the limited observation period (Table3).

CONCLUSION

Among the various treatments applied in the experiment, the Bioplantomin 3.5 l ha^{-1}(T_6) recorded the highest growth attribute and protein content which showed comparable results with Plantgro 4g l^{-1}(T_{12}), Bioplantomin 2.5 l ha^{-1} (T_5) and the control (T_{13}) showed the lowest performance. Based on above results, it may be concluded that Bioplantomin 3.5 l ha^{-1} should be applied through foliar spray to obtained maximum growth attribute and protein content in mung bean under custard-apple based agri-horticulture system.

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