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Effect of different Spacing and Phosphorus levels on growth and yield parameters of Mungbean under guava based Agri-horti System

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Abstract
A field experiment was conducted during the Kharif season of 2017-18 to find out suitable management practices to manage Agri-horticulture system under *Psidiumguajava* based agroforestry system. Suitability of experiment was based on yield of Mungbean. The yield attributes i.e pods/plant; pod length,no. of seeds/pod, seed yield; biological yield and harvest index were significantly influenced by distance and phosphorus levels. The seed yield of mungbean was significantly affected by tree management practices imposed to PsidiumguajavaL. Seed yield as affected by distance from tree was found significant in D_2(2m away from tree 762kg/ha) recorded significantly higher than D_1 (1.5m away from tree 680 kg/ha) in mungbean. Seed yield as affected by phosphorus levels were also significant. F_1(60kg p_2o_5 + PSB culture) they were found significantly superior than remaining phosphorus levels. Lowest seed yield was recorded in F_5 (controlled condition). Interaction between distance from tree and phosphorus level was found significant. The seed yield of mungbean significantly higher with combination of 2m away from tree at 60kg/ha of $P_2O_5$with PSB culture.

Keywords: Spacing, Mungbean, *Psidiumguajava*L, phosphorus, yield

Introduction
In Agroforestry, trees and agricultural crops are combined together and compete with each other for growth resources such as light, water and nutrients. Agri-Horti System is one of the important components of agroforestry in which the integration of fruit crops in crops is practiced. The resource sharing in component crop may results in complementary or competitive effect depending upon nature of species involved in the system. *Psidiumguajava* L. is one of the fast growing fruit tree species, which is being promoted for cultivation of wood, fruit based industries in the farmer's field in Uttar Pradesh state. Hence many of the small and marginal farmers in Vindhyaregion are growing this particular tree species on the field boundaries.

Mungbean (*Vigna radiate* L.) is one of the most ancient and extensively grown leguminous crops in India. Mungbean is rich source of protein and essential amino acids play an important role in making up the protein deficiency for poor. Moreover, this crop plant being leguminous improves soil fertility by fixing atmospheric nitrogen to available form through bacterial symbiosis. In addition, it is a short duration pulse crop required low input and suitable for cultivation both under rain-fed and irrigated conditions. It improves the soil fertility by fixing N through symbiosis with specific soil rhizobia of the genus Bradyrhizobium. It is primarily a rainy season crop but with the development of early maturing varieties, it has also proven to be an ideal crop for spring and summer seasons. It can also be used as a green manure crop and its green plants are used as fodder after removing the mature pods. It also contains high quality of lysine (4600 mg/ g N) and tryptophan (60 mg/ g N) and consumed as whole grain or as well as in the form of Dal for table purpose. Mungbean is supposed to be easily digestible and, hence, is mostly preferred by patients. The sprouted seeds of mungbean are rich in ascorbic acid (vitamin C), riboflavin and thiamine (Choudhary, 2010) [1].

Distance from the tree row is an important factor that determines the extent of influence to the adjoining crop. Trees imposed the competition near the tree line and reduce the growth and yield compared tocrop away from the tree line. As the distance increases from the tree row the availability of photo synthetically active radiation increases and competition for below ground resources reduces. (Patil and Channabasappa, 2008) [11]. Reduction of crop yield due to resource competition from tree hedges is a serious drawback of hedgerow intercropping. Hedgerow intercrops showed a clear reduction closer to the hedgerows, indicating significant competition from hedgerows, however, growth and yield of crops increased with increasing

distance from hedgerows (Costa and Chandrapala, 2001) [2].
Fertilizer is one of the most important factors that affect crop production. Fertilizer recommended for soil and crops is a dynamic process (Singh *et al.*, 2013) [1] and the management of fertilizer is one of the important factor that greatly affect the growth, development and yield. Phosphorus is the second most critical plant nutrient among all, but for legumes it assumes primary importance. It participates in the synthesis of vitally important substances. It also takes part in energy fixing and releasing process in the plants. Phosphorus helps in proper root development, which increases nodules per plant and consequently more nitrogen is fixed in soil by pulse crops. However, the phosphorus content is low in Indian soil and a major portion of applied phosphorus is retained in soil is in unavailable form. So, it is necessary to supplement the deficient amount of phosphorus and increase the efficiency of applied phosphorus with optimum dose of phosphorus for enhancing the production and productivity. Farmers have a wrong notion that mungbean, being legume crop does not need any nutrient and usually grow it on the marginal lands without applying any fertilizer. This seems to be an important reason for low productivity in the country.

Materials and Methods

A field experiment was conducted during kharif season of 2017-18 at Agronomy farm of Rajiv Gandhi South Campus Banaras Hindu University, Barkachha, Mirzapur, and Uttar Pradesh which is situated in Vindhya region of district Mirzapur (250 10' latitude, 820 37' longitude and altitude of 147 meters above mean sea level. This region comes under agro-climatic zone III. A (Semi-Arid Eastern Plain Zone) and the region is mostly rain-fed. Vindhya soil comes under rain-fed and has invariably poor fertility status. The soil of the experimental site was sandy loam and having 183.33 kg/ha alkaline permanganate oxidizable N, 15.55 kg/ha available P (Olsen *et al.* 1954) [9], 122.0 kg/ha 1 N ammonium acetate exchangeable K and 0.27% organic carbon (Jackson 1973) [4]. The pH of soil was 5.4 (1:2.5 soil and water ratio). Guava trees were eleven year old planted in august 2007 at a spacing of 7 X 7 meter. Mungbean was sown as an intercrop. The experiment was conducted in factorial randomized block design having five levels of Phosphorus with PSB culture i.e. P1 (60kg/ha P_2O_5 + PSB culture), P2 (30kg/ha P_2O_5 + PSB culture), P3 (60kg/ha P_2O_5), P4 (30kg/ha P_2O_5) and P5 (controlled i.e. without Phosphorus) and two level of distance i.e. 1.5 m away from the tree (D1) and 2m away from the tree (D2) in guava-mungbean agri-horti system with three replications. The treatments were randomized as per statistical procedure. Experiment consists total 10 treatment combinations. Gross plot sizes of treatment (D1 and D2) were 3 X 4.5 m and 3 X 3 m respectively. Mungbean crop was sown adjacent to fruit planted tree species at 2nd August with recommended package of practice. 'HUM-16' variety of mungbean was used for sowing.

Results and Discussion

Effect of different distance from tree and Phosphorus levels with PSB culture on growth parameters of mungbean

Effect of distance

Significant differences were observed in plant height, number of trifoliate leaves, number of root nodules/plant, number of primary and secondary branches and total dry matter accumulated of mungbean due to different distances. Growth parameters of mungbean were observed significantly higher in D2 distance (2.0m away from the tree) are plant height (37.23cm), number of trifoliate leaves number of trifoliate leaves (13.22), number of root nodules/plant (12.71), number of primary roots (4.21), number of secondary branches (3.67), total dry matter accumulated/ plant (7.70) at 40 DAS than D1 (1.50 m away from tree). The reason behind the reduction in growth parameters of mungbean with distance D1 (1.5m away from the tree) may be attributed to severe competition by the tree roots which get reduced with increase in distance from tree line.

Effect of phosphorus levels

Significant differences were observed in growth parameters due to application of different phosphorus levelsand PSB culture. Growth parameters i.e. plant height(40.51cm), number of trifoliate leaves(15.44), number of root nodules/plant(14.61), number of primary branches(5.50) and secondary branches(4.60) and total dry matter accumulated/plant(7.88) at 40 DAS are highest when phosphorus was applied at level of 60kg/ha with PSB culture and lowest under control condition when no phosphorus is applied. Interaction between distance and phosphorus levels was found non-significant for growth parameters.

Table 1: Effect of different distance from tree and Phosphorus levels with PSB culture on growth parameters

Treatment	Plant height(cm)	No. of trifoliate leaves	No. of root nodules/plant	No. of primary branches	No. of secondary branches	Total dry matter accumulated/plant
D- Distance from tree						
D1- 1.5m away from tree	36.15	3.03	11.80	3.83	3.32	7.56
D2- 2.0m away from tree	37.23	3.37	12.71	4.21	3.67	7.70
CD(0.05%)	0.48		0.36	0.36	0.33	0.14
P- Phosphorus levels with PSB culture						
P1- 60kg/haP_2O_5+ PSB culture	40.51	3.87	14.61	5.50	4.60	7.88
P2- 30kg/ha P_2O_5+ PSB culture	38.07	3.57	12.89	4.39	3.96	7.71
P3- 60kg/ha P_2O_5	36.19	3.35	12.33	3.78	3.67	7.67
P4- 30kg/ha P_2O_5	35.18	2.90	11.83	3.49	2.81	7.61
P5- Control	33.48	2.30	9.61	2.94	2.44	7.28
CD(0.05%)	0.76	0.52	0.57	0.56	0.52	0.23

Effect of different distance from tree and Phosphorus levels with PSB culture on yield parameters

Effect of distance

Results of the experiment were revealed that the yield parameters were observed significant with distance from tree i.e. number of pod/ plant, pod length, number of seeds/pod, seed yield, biological yield and harvest index (Table 2). Yield parameters of mungbean were observed significantly higher in D2 distance (2.0 m away from tree) from tree, number of pod/ plant (10.52), Pod length (6.97cm), number of seeds/pod

(8.77), seed yield (698.53 kg/ha), biological yield (2775 kg/ha) and harvest index (26.55%) than D1 (1.50 m away from tree). Guava offered the maximum competition near the tree line (1.5 m) and reduced the seed yield up to 15.90 %, compared to away from the tree line (2.0 m). The maximum seed yield of mungbean was recorded in 2.0 m away from the tree row (698.53 kg/ ha) which was significantly higher than 1.5 m away from tree row (665.66 kg/ ha). The extent of reduction in the yield of mungbean near the tree row i.e. 1.5 m away from tree line may be attributed to severe competition by the tree roots which get reduced with increase in distance from tree line and shade from the guava tree also might have reduced the yield parameters near the tree row. This reduction in the seed yield near the tree row may also be due to lower soil moisture and low availability of light near the tree row and also harmful impact of these factors observed in the reduction of yield parameters. Similar findings recorded by Patil *et al*. (2011) [10]; Kaushal and Verma, (2013) [5].

Effect of Phosphorus levels

Results of the experiment were revealed that increased phosphorus level UPTO 60kg/ha with PSB culture recorded the enhanced pod length (8.07cm), number of pods/plant (12.05), number of seeds/pod (9.85), test weight (28.98g), seed yield (861.08 kg/ha), biological yield (2962.15 kg/ha), straw yield and harvesting index (27.68%) over the remaining phosphorus levels. It was due to enhanced vegetative growth in terms of dry matter production and branches/ plant provided more sites for the translocation of photosynthates and ultimately resulted in increased yield parameters which were significantly benefitted with the availability of nutrients during crop growing season that ultimately contributed towards higher yield (Table 2).

TABLE 2: Effect of different distance from tree and Phosphorus levels wiyh PSB culture on yield parameters of mungbean under guava (Psidiumguajava L.) based agri-horticulture system

Treatment	No. of pods/plant	Pod length(cm)	No. of seeds/pod	Test weight(g)	Seed yield(kg/ha)	Biological yieldkg/ha()	Harvest index (%)
D- distance from tree							
D1- 1.5m away from tree	9.68	6.89	8.32	27.88	665.66	2654.94	24.65
D2- 2.0m away from tree	10.52	6.97	8.77	28.15	698.53	2698.58	25.01
CD(p=0.05)	0.49	0.07	0.33	NS	17.15	15.87	0.34
P- Phosphorus levels with PSB culture							
P1- 60kg/ha P_2O_5+ PSB culture	12.05	8.07	9.85	28.98	861.08	2962.15	27.68
P2- 30Kg/ha P_2O_5 + PSB culture	11.12	7.37	9.28	28.90	762.91	2816.59	26.38
P3- 60kg/ha P_2O_5	10.39	6.87	8.81	28.16	724.70	2774.36	25.82
P4- 30kg/ha P_2O_5	9.17	6.28	7.90	27.19	582.77	2539.77	23.11
P5- Control	7.77	6.05	6.90	26.84	479.00	2291	21.15
CD (p=0.05)	0.78	0.10	0.52	0.59	27.11	25.10	0.54

It is an established fact that nitrogen and phosphorus plays an important role in the formation of new shoots thereby; increase in the number of branch/ plant and PSB culture increases the number of root nodules/plant. In addition, it regulates the photosynthesis and carbohydrate metabolism which can be considered to be one of the major factors limiting growth particularly during the reproductive phase. As stated earlier, the adequate supply of phosphorus along with PSB culture play a vital role in metabolic process of photosynthesis that result in increased flowering and fruiting and increasing root nodules thereby improving number of pod/ plant, number of seed/ pod and test weight. The increase in above parameters with the application of phosphorus to its appropriate level might be due to its favourable effect on growth parameters. The significant increase in number of pod/ plant due to the application of 60kg/haP_2O_5+ PSB culture might be on account of better removal and translocation of nutrients, especially phosphorus, resulting in higher number of pod/ plant. The results were in close conformity with the observations recorded by Meena (2005) [7]; Meena (2013) [8].

Interaction between distance from tree and phosphorus level with PSB culture was found significant for seed yield (kg/ha). Seed yield was found significantly higher in interaction with distance D2 (2.0m away from tree) and P1 (60kg/ha P2O5+ PSB culture) is 898.50 kg/ ha. The least yield was found in D1 distance (1.5m away from tree) with no phosphorus. And remaining treatment interaction effect in same such as given below, it means the interaction between P and D recorded significant difference at the time of harvesting.

Interaction between distance from tree and phosphorus levels for seed yield (kg/ha)

Treatment	Yield					
DxP	P1	P2	P3	P4	P5	**Average**
D1	823.67	731.93	716.20	578.11	478.36	665.66
D2	898.50	793.88	733.20	587.43	479.63	698.53
Mean	861.08	724.70	724.70	582.77	479.00	
SEm±	12.91					
CD(P=0.05)	38.34					

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