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Effect on quality and yield of summer groundnut as influenced by biofertilizers

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Abstract
Present investigation was carried out at AICRP on groundnut, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (Maharashtra). The experiment was laid out in factorial randomized block design with three replications. The treatments consisted of three levels of recommended dose of fertilizers viz., 100 %, 75 % and 50 % and biofertilizers viz., *rhizobium* (liquid) *rhizobium* (solid), phosphorus solubilizing bacteria, and control. The *rhizobium* (liquid) significantly increased the quality attributes viz., number of mature and immature pods plant^{-1}, 100 kernel weight, shelling percentage, resulting in significant increase in groundnut yield (5540.33 kg ha^{-1}) due to treatment *rhizobium* (liquid) as compared to control (4556.00 kg ha^{-1}). The 100 % RDF recorded significantly higher yield of groundnut (5423.00 kg ha^{-1}) over 75 % and 50 % RDF. Based on one year of experimentation, it could be concluded that the growing of RHRG-6021 variety of groundnut under inoculation of *rhizobium* (liquid) with 100 % RDF found significantly superior for higher yield and monetary benefit during summer season.

Keywords: Groundnut, biofertilizers, *Rhizobium*, and yield

Introduction
Groundnut (*Arachis hypogaea* L) is the fore most important oil seed crop of India, in terms of area and production. It occupies an important position among the oilseed crops in the world. India which adopt groundnut crop by late nineteenth century, gradually became the major groundnut producing country in the world within a span of 5-6 decades, groundnut is known to be unique and important oilseed crop of India. Groundnut (*Arachis hypogaea* L) a member of family leguminaceae. The origin of groundnut is Central America. It is an essential and can be grown under tropical and subtropical climatic conditions; it is grown under mean temperature between 25-28 ^{0}C. It is grows well in region where 500-1200 mm annual rainfall is received. Edible oils and fats have an important place in our diet. Groundnut is also recognized as poor man's nut. Groundnut kernels are rich in proteins and vitamins viz., A, B, B1, k. Kernels are consumed raw, roasted, salted or sweetened. The reducing sugars in groundnut are low (1.2 to 1.8 per cent). Sucrose is the most important sugar, which ranges between 2.86 to 6.35 per cent. Glucose, fructose and galactose are the other minor sugars present. It is rich source of minerals like phosphorus, calcium, magnesium, potassium, zinc, copper, iron and manganese (Nagraj, 1995). About 200 g of groundnut can easily furnish recommended dietary allowance of minerals as prescribed by FAO. Inoculation of groundnut with efficient competitive rhizobia was considered as a beneficial practice since the native rhizobia were not able to supply the total nitrogen requirements of groundnut (Hadad *et al*., 1986) [2]. Similarly, the low yield of groundnut in India was suggested to be due to low nodulation and to comptetition from indigenous ineffective strains (Basu and Bhadoria, 2008) [1]. While utilize Bio-fertilizers importing a large population of effective microorganisms in the active field of root system, increase plants power to absorb more nutrients (khavazi *et al.*, 2005) [3].

Rhizobactries as a part of a global management system reduce use of synthetic compounds and chemical fertilizers and provides sustainable agriculture (Muhammad *et al*., 2008) [4]. Production of *rhizobium* inoculums types of biological fertilizers, especially in developed countries and developing countries are carried out with different motivations.

Bio-fertilizers can play an important role in meeting the nutrient requirement of crops through biological nitrogen fixation (BNF), solubilization of insoluble phosphorus sources (PSB), extend the nutrient absorption to zones not accessible to plant roots (VAM). Therefore introduction of efficient strain of *rhizobium* in the soil which is poor in nitrogen may be helpful in boosting up production and consequently more nitrogen fixation. Several bacteria belonging to genera Pseudomonas and Bacillus have the ability to solubilize inorganic phosphorus insoluble sources. Inoculation of seed with phosphate solubilizing bacteria (PSB) increases crop growth, nutrient availability, uptake and crop yield.

Materials and Methods

A field experiment on groundnut was conducted at AICRP on groundnut, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar. The present investigation was undertaken during the *Kharif* season. The experiment was laid out in factorial randomized block design with three replications. The treatment consisted of *rhizobium* (liquid) *rhizobium* (solid), phosphorus solubilizing bacteria, and control, with 100, 75, and 50 per cent RDF with variety. RHRG-6021. The soil of the experimental field was black sandy in texture with moderate in available nitrogen (280.32 kg ha^{-1}), high in available phosphorous (32.55 kg ha^{-1}) and very high in available potassium (362.25 kg ha^{-1}) with slightly alkaline in reaction (PH 7.75). The electrical conductivity of soil was 0.28dSm-1 and organic carbon content was 0.55%. The initial values of the field capacity, permanent wilting point and bulk density were 25.45%, 13.17% and 1.41 g cm^{-3}, respectively. The seeds were sown on15th March, 2014 at spacing of 30 cm × 10 cm. The irrigation was given at whenever necessary. The cultural recommended operations and plant protection measures were carried out timely.

Results and Discussion

1. Mean number of mature pods per plant

A. Effect of biofertilizers

The differences in respect of number of mature pods plants^{-1} due to various treatments were statistically significant. The treatment *rhizobium* (liquid) (25.68) recorded the significantly highest mature pods (25.68) plants^{-1} followed by *rhizobium* (solid) (24.91) and PSB (22.62) over control.

B. Effect of fertilizer

The number mature pods per plant^{-1} in groundnut were influenced significantly due to different levels of fertilizers. The 100 % RDF exhibited significantly higher number of mature pods (24.91) plant^{-1} compared to 75 % and 50 %.

C. Effect of Interaction

The interaction effect of different biofertilizers and fertilizers was found to be significant in respect of mature pods plant^{-1} in groundnut. Interaction effect of biofertilizers and fertilizers on number of pegs plant^{-1} found statistically significant. It was observed that interaction of *rhizobium* (liquid) and 100 % RDF recorded the significantly highest number of pegs (88.25) plant-1 followed by *rhizobium* (solid) and phosphorus solubilising bacteria over rest of combinations.

2. Mean number of immature pods per plant

A. Effect of biofertilizers

The differences in respect of number of immature pods plant^{-1} due to various treatments were statistically significant. The treatment *rhizobium* (liquid) recorded lowest number of immature pods (4.73) plants^{-1} followed by *rhizobium* (solid) (6.40) and phosphorus solubilizing bacteria (7.27) over control.

B. Effect of fertilizer

The number of immature pods plants^{-1} was influenced significantly due to different levels of fertilizers. The 100 % RDF exhibited significantly lower number of immature pods (4.26) plant^{-1} as compared to 75 % and 50 % RDF.

C. Effect of Interaction

The interaction effect of different biofertilizers and fertilizers was found to be non-significant in respect of immature pods plant^{-1} in groundnut.

3. Mean 100 kernel weight (g)

A. Effect of biofertilizers

The differences in respect of mean 100 kernel weight due to various treatments were statistically significant. The treatment *rhizobium* (liquid) (44.23g) recorded the highest 100 kernel weight (44.23g) followed by treatment *rhizobium* (solid) (43.78g) over the control.

B. Effect of fertilizer

The 100 kernel weight was influenced significantly due to different levels of fertilizers. The 100 % RDF exhibited significantly highest 100 kernel weight (54.60g) as compared to 75 and 50 % RDF.

C. Effect of Interaction

The interaction effect of different biofertilizers and fertilizers was found to be significant in respect of 100 kernel weight in groundnut. It was observed that interaction of *rhizobium* (liquid) and 100% RDF recorded the significantly highest100 kernel weight (54.60g) followed by *rhizobium* (solid) and phosphorus solubilizing bacteria over rest of combinations.

4. Mean shelling percentage

A. Effect of biofertilizers

The differences in respect of shelling percentage due to various treatments were statistically significant. The treatment *rhizobium* (liquid) recorded the highest shelling percentage (69.02%) followed by *rhizobium* (solid) (68.32%) over control.

B. Effect of fertilizer

The shelling percentage was influenced significantly due to different levels of fertilizer. The 100 % RDF exhibited significantly higher shelling percentage (73.56%) as compared to 75 % (70.33%) and 50 % RDF.

C. Effect of Interaction

The interaction effect of different biofertilizers and fertilizers was found to be significant in respect of shelling percentage in groundnut. Interaction effect of biofertilizers and fertilizers on harvest index found statistically significant. It was observed that interaction of rhizobium (liquid) and 100 % RDF recorded the significantly highest harvest index (39.51) followed by *rhizobium* (solid) and phosphorus solubilizing bacteria over rest of combinations.

5. Mean dry pod yield kg ha^{-1}

A. Effect of biofertilizers

The differences in respect of dry pod yield kg ha^{-1} due to various treatments were statistically significant. The treatment *rhizobium* (liquid) (recorded the highest dry pod yield 5540.33 kg ha^{-1} followed by *rhizobium* (solid) (5369.03 kg ha-1) and PSB (4862.66 kg ha-1).

B. Effect of fertilizer

The dry pod yield kg ha^{-1} was influenced significantly due to different levels of fertilizers. The 100 % RDF exhibited significantly higher dry pod yield (5423.00 kg ha^{-1}) followed by 75 % (5142.75kg ha^{-1}) over 50 % RDF.

C. Interaction

The interaction effect of different biofertilizers and fertilizers was found to be significant in respect of dry pod yield kg ha^{-1} in groundnut. It was observed that interaction of *rhizobium* (liquid) and 100%RDF recorded the significantly highest dry weight of pod plant^{-1} (27.79g) followed by *rhizobium* (solid) and phosphorus solubilising bacteria over rest of combinations.

Table 1: Effect of biofertilizer on Number of mature and immature pod per plant, 100 kernel weight, Shelling percentage, Dry pod yield of Groundnut.

Treatment	Number of mature pod per plant	Number of immature pod per plant	100 kernel weight (g)	Shelling percentage	Dry pod yield (Kg ha^{-1})
Biofertilizer (B)					
Control (B1)	20.77	7.37	40.49	63.31	4556.00
Rhizobium (liquid) (B2)	25.68	4.73	44.23	69.02	5540.33
Rhizobium (Solid) (B3)	24.91	6.40	43.78	68.23	5369.03
PSB (B4)	22.62	7.27	42.67	67.33	4862.66
S.Em. ±	0.133	0.078	0.43	0.234	58.40
C.D. at 5 %	0.391	0.228	1.28	0.686	171.30
Fertilizer (F)					
100% RDF (F1)	24.91	4.26	38.65	68.91	5423.00
75% RDF (F2)	23.71	5.61	37.58	66.68	5142.75
50% RDF (F3)	21.85	7.26	30.99	65.40	4552.52
S.Em. ±	0.369	0.215	1.21	0.647	161.72
C.D. at 5 %	1.082	0.632	3.55	1.898	474.32
Interaction (B x F)					
S.Em. ±	0.738	0.431	2.42	1.294	323.45
C.D. at 5 %	2.164	NS	7.10	3.797	808.55
General mean	23.52	6.12	39.77	67.00	5039.41

Table 2: Interaction effect of biofertilizer and fertilizer on number of mature pods per plant.

	Biofertilizer (B)			
Fertilizer (F)	**Control(B1)**	***Rhizobium* (liquid) (B2)**	***Rhizobium* (solid) (B3)**	**Phosphorus solubilizing bacteria (B4)**
100% RDF - F1	26.29	30.83	28.16	27.28
75% RDF - F2	22.09	25.27	23.45	23.29
50% RDF - F3	19.27	23.27	22.76	21.59
S.Em. ±	0.73			
C.D. at 5 %	2.16			

Table 3: Interaction effect of biofertilizer and fertilizer on 100 kernel weight (g)

	Biofertilizer (B)			
Fertilizer (F)	**Control(B1)**	***Rhizobium* (liquid) (B2)**	***Rhizobium* (solid) (B3)**	**Phosphorus solubilizing bacteria (B4)**
100% RDF - F1	48.49	54.60	52.59	49.90
75% RDF - F2	43.33	45.09	45.02	44.09
50% RDF - F3	38.30	42.50	42.32	40.32
S.Em. ±	2.67			
C.D. at 5 %	7.84			

Table 4: Interaction effect of biofertilizer and fertilizer on shelling percentage.

	Biofertilizer (B)			
Fertilizer (F)	**Control(B1)**	***Rhizobium* (liquid) (B2)**	***Rhizobium* (solid) (B3)**	**Phosphorus solubilizing bacteria (B4)**
100% RDF - F1	71.00	73.56	71.73	71.34
75% RDF - F2	65.19	70.33	68.04	65.73
50% RDF - F3	54.71	66.03	64.62	61.66
S.Em. ±	1.29			
C.D. at 5 %	3.79			

Table 5: Interaction effect of biofertilizer and fertilizer on dry pod yield kg ha^{-1}.

	Biofertilizer (B)			
Fertilizer (F)	**Control(B1)**	***Rhizobium* (liquid) (B2)**	***Rhizobium* (solid) (B3)**	**Phosphorus solubilizing bacteria (B4)**
100% RDF - F1	5212.00	5960.00	5671.00	5497.00
75% RDF - F2	4343.00	5412.00	5033.00	4687.00
50% RDF - F3	3966.00	4990.00	4190.00	4166.00
S.Em. ±	323.45			
C.D. at 5 %	808.55			

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