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Effect of part replacement of chemical fertilizers with organic and bio-organic agents in ground nut, *Arachis hypogea*

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Abstract

Field trials were conducted during the years 2009-2010, at a private farm in Puttaparthi, Anantapur District, India, to study the effect of biological agents along with recommended doses of NPK and organic farm yard manure (FYM) on ground nut plants, *Arachis hypogea*. Different treatment combinations were employed, 75%, 50% or 25% of NPK and FYM were tested for partial replacement. In addition, 3 biological agents, BGA, *Azotobacter* and *Azospirillum*, were studied along with NPK and FYM combinations, to analyze the use of biofertilizers with organic and chemical fertilizers. The use of biological agent, as a part replacement for chemical fertilizers has revealed an overall improvement in crop parameters studied. The combination 75% FYM+25%NPK gave best results in terms of yield, protein and oil content. Also, combining all three biological agents proved to yield better results in each of the parameters studied.

Key words: biofertilizer, *Arachis hypogea*, yield FYM, NPK, BA, BGA

Introduction

Enormous quantities of organic and inorganic compounds are released into the environment each year as a result of human activities.One of the major concerns in today's world is the pollution and contamination of soil. The use of chemical fertilizers and pesticides has caused tremendous harm to the environment. An answer to this is the biofertilizer, an environmentally friendly fertilizer.

Biofertilizers are defined as biologically active products or microbial inoculants of bacteria, algae and fungi (separately or in combination), which may help biological nitrogen fixation for the benefit of plants. Biofertilizers also include organic fertilizers (manure, etc.), which are rendered in an available form due to the interaction of micro-organisms or due to their association with plants.

Biofertilizers thus include the following, symbiotic nitrogen fixers Rhizobium spp. asymbiotic free nitrogen fixers (Azotobacter, Azospirillum, etc.), algae biofertilizers (blue green algae or BGA in association with Azolla), phosphate solubilising bacteria, mycorrhizae, organic fertilizers. The most striking relationship that these have with plants is symbiosis, in which the partners derive benefits from each other.

NPK from organic sources, such as FYM can be used as a sole source or as a substitute for inorganic fertilizers. Increasing the yield of groundnuts by using integrated action of both chemical and bio-organic fertilizers have been reported by many researchers.

Nagaraj *et. al.,*., (2001) have shown that 7.5 t/ha FYM + NPK (25:32:20) produced the highest pods and seed yield/ha. Subramaniyan *et. al.,* (2000), have shown that increasing organic manure in the form of FYM to 15t/ha, can maximize pods, seeds yield/ha in groundnut. Abd El Rasoul *et. al.,* (2002) have shown significant increase in peanut yield using bio and organic fertilizers. Kumaran (2001), has shown in his investigation on response of groundnut to organic manure & fertilizer levels that utilization of recommended dose of NPK (25:75:37) + 10 t/ha FYM gave the highest number of pods/plant, haulm and seed yield. Venkataramana *et. al.,* (2002) showed significant increase in pods, seeds and haulm yields/ha by FYM upto 15 t/ha. The integrated nutrient management by bio-organic and chemical fertilizers has recorded 35% increase in yield by Thakare *et. al.,* (2003). Laxminarayana *et. al.,* (2004) have also shown significant improvement in groundnut yield on application of organic and inorganic manures.

The use biofertilizers along with FYM has also been in studied. Use of BGA for rice cultivation is worth mentioning. El Habbasha *et. al.,* (2005), have shown that use of bio-fertilizers have improved the yield of groundnuts considerably. Badole *et. al.,* (2001, 2004), have stated that combined application of 5t/ha FYM + ¾ recommended dose of NPK increased no of pods/plant, seed index, seed protein & oil content. They have the same result on addition of *Azotobacter* as biofertilizer. El Kramany *et. al.,* (2007), have shown that combining ¼ recommended dose of NPK with ¾ FYM and bio fertilizer microbein resulted in highest seed & pod yield, oil and protein content in poor sandy soils.

Groundnut (*Arachis hypogea*) is considered one of the most important oilseed crops in the world. Being the main crop grown in Rayalseema District of Andra Pradesh, thus, the cultivated area of groundnut in Puttaparthi, Anantapur district is quite high. Owing to poor soil conditions, use of chemical fertilizers has increased greatly in this area. Hence, the coincident application of organic manures and bio-fertilizers is frequently recommended for improving biological, physical and chemical properties of soil and also to increase the productivity.

This work in an attempt to try to use NPK from organic sources such as Farm Yard Manure solely and in combination with biofertilizers , as a substitute for inorganic sources.

Materials and Methods :

A series of field trails were carried out in a farm in Puttaparthi Mandal, Anantapur District, during both the growing periods, Jan – May and July – Dec, each year. Soil was cleaned and deweeded prior to cultivation. The experiments were carried out in 2 steps: 1. To study part replacement of organic fertilizers and chemical fertilizers. 2. To identify best combination of biological agent to serve as biofertilizer.

The experimental land was divided into blocks, each bearing one treatment combination. Each plot had 5 rows (4 cm in length and 50 cm apart). Seeds were sown 10cm apart in third week of Jan (season1) and July (season 2). 12 seeds were sown in

each row in the plots, thereby maintaining 60 plants for each treatment. In the first expirement, Farm Yard Manure (FYM) & NPK were used in recommended dose. FYM and NPK were maintained in ratio of 1:3, 1:1 and 3:1 respectively. In the second experiment, each of this combination was treated with biological agents - BGA, *Azotobacter* and *Azospirillum*, individually and in combination with each other. The biological agents were added to the experimental plot, 10 days before sowing. Recommended dosage of NPK alone was used as control.

Table 1 . Different treatment parameters studied

Treatment No	Treatment
CONTROL	ONLY NPK
T1	25% FYM + 75% NPK
T2	50% FYM + 50% NPK
T3	75% FYM + 25% NPK
T4	75% FYM + 25% NPK + Azotobacter
T5	75% FYM + 25% NPK + BGA
T6	75% FYM + 25% NPK + Azospirillum
T7	75% FYM + 25% NPK + Azospirillum + Azotobacter
T8	75% FYM + 25% NPK + BGA+ Azotobacter
T9	75% FYM + 25% NPK + BGA+ Azospirillum
T10	75% FYM + 25% NPK + BGA+ Azotobacter+ Azospirillum

Commercial samples of all biological agents were obtained from Agricultural Bacteriologist, College of Agriculture, Pune. Gypsum was added to the crops at the end of 60 days and 75 days. The different parameters mentioned below were assessed at harvest, 120 days after plantation. 1. Pod yield– no of pods/plant ; 2. Seed yield - no of seeds/pod ; 3. quality of produce – no of good seeds/pod ; 4. weight of pods/plant (g/plant) ; 5. seed index – 100 seed weight (g); 6. protein and oil content of seeds – seed weight X oil% or protein in seed. Oil and protein% in seeds were calculated as described by Chapmann *et. al*.,.(1978). All the data was statistically analysed. The least significant difference was used to compare means.

Results and Discussion :

1. Yield - As per the data given in Table 1, significant difference was observed in both the yield parameters studied. While 1:3 FYM : NPK showed a decrease in productivity of both pods/plant and seeds/plant, the treatment with 50% of both FYM and NPK showed a marginal increase in each of the parameter. However, the treatment 3:1 FYM:NPK has proved to be the best among the different concentrations of FYM & NPK, with an yield of around 24 pods/plant as against 19 in the control & 1.6 seeds/plant over 1.2 in the control and 39 seeds overall over 23.4 in control. (Fig1.)

In addition, all the combinations gave better results when seeds treated with the 3 biological agents. The general trend observed for all the 3 biological agents used was that, rather than individually, they enhanced the yield in combination with each other. While, combining Azotobacter and Azospirrilum gave better results than the other combinations among the 3, of the range, 27.4, 2.0, 54.8 respectively, for pods/plant, seeds/pod & seeds/plant, the best results were obtained when all the 3 agents were combined, of the order, **30.5**, **2.4** and **71.6 r**epsectively, as against 19.5, 1.2 , 23.4 respectively in the control. (Fig.1)

2. Weight of seeds – The weight of seeds was slightly less than double in the combination 3:1 FYM:NPK. However the addition of different biological agents has shown to have a positive effect on this aspect. While BGA alone could not augment the weight, *Azospirillum* and *Azotobacter* have done a good job, both individually as well as in combination. However, a mixture of all the 3 of them has boosted the value to108.7g/plant for pods and 46.2 g/plant for the seeds, in comparison with the control.

Table 2 . Effect of different tratment parameters on Yield, Weight, Protein and Oil content of *Arachis hypogea*

	YIELD		**WEIGHT**		**NUTRITIVE VALUE**	
TREATMENT	**pods/plant**	**seeds/plant**	**pods**	**seeds**	**protein content**	**oil content**
CONTROL	19.5	23.4	44.0	27.5	22.1	51.12
T1	17.1	19.6	41.6	32.5	22.3	51.48
T2	18.3	24.4	49.4	32.9	21.7	51.5
T3	**24.4**	**39.0**	**72.1**	**45.1**	**25.3**	**55**
T4	20.0	21.0	37.1	28.3	22.7	52.08
T5	22.4	30.3	48.8	36.2	23.4	53.28
T6	21.3	30.7	53.0	34.7	23.2	53.48
T7	21.8	32.8	54.5	32.7	23.0	52.1
T8	24.0	39.5	60.9	37.0	24.2	52.64
T9	27.4	54.8	90.5	45.2	25.8	56.46
T10	**30.5**	**71.6**	**108.7**	**46.2**	**26.3**	**57.2**

Fig 1. Effect of treatment combinations on seeds and pods yield in *Arachis hypogea*

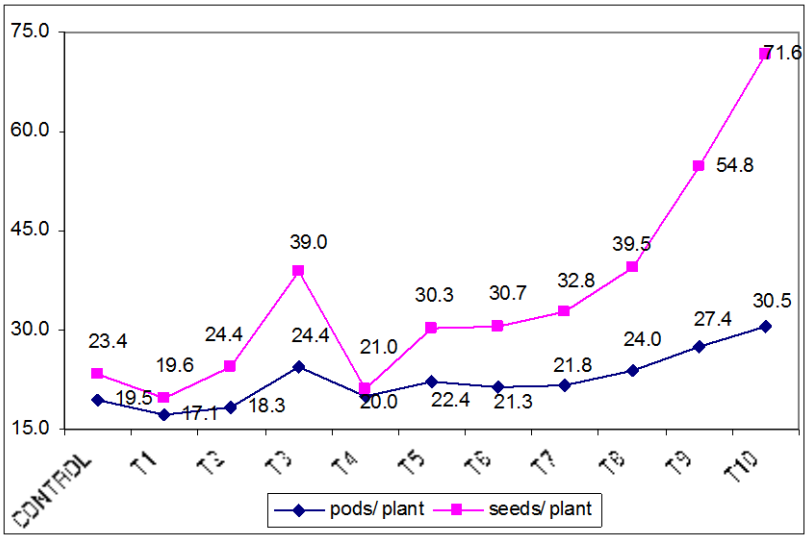
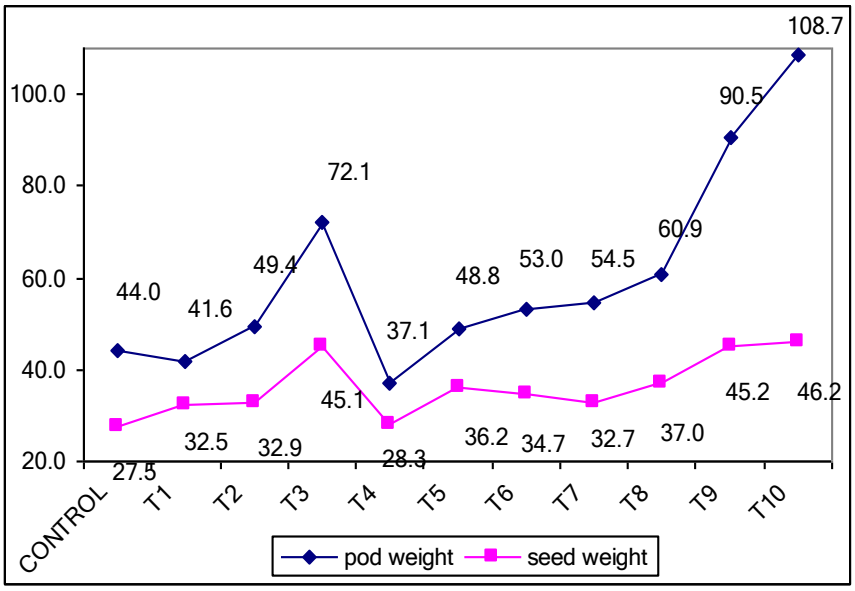


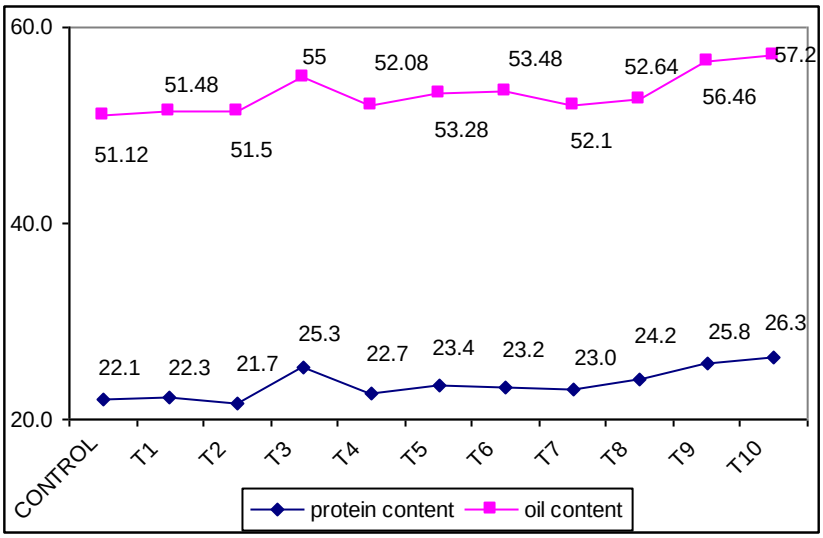
Fig 2. Effect of treatment combinations on seed and pod weight in *Arachis hypogea*



3. Nutritive value : oil content & protein – As per data given in Table 1, the nutritive value is showing a progressive improvement with inceasing FYM, coupled with decreasing NPK(Fig.3). As in the case of yield, the combination 3:1 FYM:NPK has given the highest protein content of 25.3 and oil content of 55% as against the control.

With reference to the use of biological agents, each of them has a positive impact on both seed protein as well as oil content. Among the 3 used individually, *Azospirillum* has resulted in the highest yield of both the parameters, of 23.2 and 53.48%. While used in combination with each other, BGA + *Azospirillum* proves better than BGA + *Azotobacter*.(Fig3.). Combination of *Azotobacter* & *Azospirillum*, have recorded an overall increase of 5.3% increase in oil content and 3.7 % increase in protein content in comparison to the control. However, the combination of all three has yielded the best results, an increase of 6.08% & 4.2 % on oil and protein content respectively as against the control. This suggests the use of combination of biological agents as biofertilizers to augment the commercial value of the crop.

Fig 3. Effect of treatment combinations of protein and oil content in *Arachis hypogea seeds*



Conclusion:

The use of bio-organic fertilizers in agriculture has been recoginzed of late, as a better substitue to cemical fertilizer, in regard to the environment friendly attribute of the former and the harmful effect ofthe latter on human health. While, being environment friendly, bio-organic fertilizers, also improve the physical properties of the soil, water retention capacity, prevent nutient depletion and add value to the crop grown. In regard, to this, as revealed in the present study, the combination of 3:1 FYM:NPK has showed best reults in terms of yield, oil and protein content of the crop, asd against the use of recommended use of NPK alone. In addition the use of biological mixture of BGA, *Azospirillum* and *Azotobacter* along with this 3:1 combination has significantly increased the nutritive value of the crop, thereby adding commercial value to the crop.

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