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Contemporary impact of fly ash with soil and growth hormone on germination status of Peanut (*Arachis hypogaea* L.)

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Abstract

The work represents the effect of fly ash in germination of *Arachis hypogaea* L. with different treatment with growth hormone and soil. In the present study, pot experiment has conducted by using different combinations of soil, fly ash, Sodium, Phosphorus, Potassium, Indole Acetic Acid and Gibbrellic Acid NPK, IAA and GA for estimation of plant growth parameters viz seed germination, number of leaves, leaf area, root and shoot length in *Arachis hypogaea*. Under the combination E (Soil 70% + Fly ash 30% + NPK (600:400:200) mg/pot + $1.42x10^{-5}$m IAA + $6.42x10^{-5}$ m GA) best result for the enhancement of all growth parameters have been recorded. The chlorophyll a, b and total chlorophyll content was also higher under the treatments. The present work can give ideas on germination status of other leguminous plants or herbs. Role of fly with soil in different combination may be more productive in crops.

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Introduction

Arachis hypogaea, the peanut or groundnut, is an annual herbaceous plant in the Fabaceae (legume or bean family) that originated and was domesticated in South and Central America 3,500 years ago, and is now grown in tropical and warm-temperate regions worldwide for its seeds and their oil. Although appearing as and referred to as a nut, it is actually the underground pod of a legume, rather than a true nut. The peanut plant has procumbent stems and grows to around 0.5 m tall or long. Leaves alternate compound, with 4 ovate to oblong leaflets, up to 6 cm long; Flowers yellow, tubular; Fruit legume typically containing 1-3 soft seeds (sometimes as many as 6), each covered with a reddish brown, papery membrane. The use of fly ash as a liming agent not only in mono but also in dicotyledonous plants for better crop yields (Ahmad *et al.,* 1986; Sarangi and Mishra, 1998; Singh and Siddhiqui, 2003). The fly ash has similar physicochemical properties with soil and it can mix homogeneously and improve agronomic properties of soil (Chang *et al.,* 1979), so fly ash is a treasure of trace elements, makes the trace element readily available to the crop when mixed with soil (Dreher, 1975; Plank and Morteus, 1974) has tremendous potential as a nutrient supplement and plays a favourable role in increasing growth and yield of ground nut (Sarangi and Mishra, 1998). The Indole Acetic Acid (IAA) and Gibberellic acid (GA) has help protein and oil synthesis to increase respiration rate in soil (Goyel *et al.,* 2002; Chaddha 1998; Bozkurt and Karachal, 2001; Bhandari, 2006). The IAA and GA hormone has increased the germination percentage in linseed crop (Rao and Gideron, 1957). The IAA and GA also increased the stem and root elongation and the plant growth parameters like root length, shoot length, number of leaves and leaf area. Increased groundnut yields with application of Zn, B and S have been made by Chitdeshwari and Poongathai (2003), the dark calcareous soil are highly deficient in Fe & Zn (Vijayasekhar *et al.,* 2000). There are more literature related on cultivated crops with growth hormone/promoter, but research on effect of fly ash on plant growth is less. The present work is representing the trends in number of leaves, length of root & shoot. There is a lot of work may be done in agriculture field for better result. We can find out the germination status and root, stem and leaves growth in leguminous crop.

Material and Methods

In the present experiment, 120 pots containing 40 different combinations of soil, fly ash, NPK, IAA and GA has been used in triplicate. The plant growth parameters viz seed germination (%), number of leaves, leaf area (cm^2), plant root length (cm) and plant shoot length (cm) has been taken in to the consideration. After estimation of the plant growth parameters, the five combinations (A-E) pots has selected for present study. The combinations patterns are as following: Combination A= Plain soil, Combination B = Plain soil +NPK (600:400:200) mg pot^{-1}, Combination C = Soil 90% + Fly ash 10% + NPK (600:400:200) mg pot^{-1}, Combination D = Soil 80% + Fly ash 20% + NPK (600:400:200) mg pot^{-1}, Combination E = Soil 70% + Fly ash 30% + NPK (600:400:200) mg pot^{-1} + $1.42x10^{-5}$m IAA + $6.42x10^{-5}$ m GA (Fig 1-5 respectively).

Calculation of Chlorophyll content

The chlorophyll has extracted in 90% Acetone from 1gm leaves of *Arachis* and absorption coefficient, amount of chlorophyll a, b and total chlorophyll has been estimated. The 1 gm of well mixed representative sample of leaves has been finally cut and grind with 20 ml of 80% acetone then supernatant liquid has transferred to a 100 ml volumetric flask. The procedure has repeated till residue become colourless. The volume has made up to 100 ml mark with 80% acetone in all the three cases individually.

The amount of Chlorophyll was calculated using the formula mentioned below: **i.** mg chlorophyll a / gm of leaves = 12.7 (A615) x V/1000 x W, **ii.** mg chlorophyll b / gm of leaves = 22.9 (A615) 4.68 (663)xV/1000xW, **iii.** mg total chlorophyll / gm of leaves = 20.2 (A645)-8.02 (AX663)xV/1000xW

Here, A = Absorbance at specific wave lengths, V = Final volume of chlorophyll extract in 80% acetone, W = Fresh weight of leaves extracted.

In Chlorophyll a and b, carotenoids has extracted from the leaves and estimated and the absorbance has measured at 645, 663 and 480 nm using spectrophotometer against 80% acetone as blank. Finally, the chlorophyll content has calculated from Arnon formula (1958).

Table 1. Germination (%) of *Arachis hypogaea* at different combinations with fly ash.

S.N.	Combinations	Germination percentages
1.	A (Plain soil)	42
2.	B (Plan Soil + NPK)	48
3.	C (10%FA+90%Soil+NPK)	66
4.	D (20%FA+80%Soil +NPK)	78
5.	E (30%FA+70%Soil +NPK+GH)	99

Here, NPK= Nitrogen: Phosphorus: Potassium, FA= Fly Ash, GH=Growth Hormones (IAA+GA)

Table 2 Leaf formation at different combination levels with fly ash in *Arachis hypogaea* L.

S. N	Combinations	Number of leaves per pot (10 plants in each pots)	Leaf area (cm^2)	Stem length (cm^2)	Root length (cm^2)
		In 45 days	In 45 days	In 45 days	In 45 days
1.	A (Plain soil)	243	2604.71	48.12	16.2
2.	B (Plan Soil + NPK)	264	3001.89	50.53	16
3.	C (10%FA+90%Soil+NPK)	276	3520.95	52.46	18.8
4.	D (20%FA+80%Soil +NPK)	306	3873.87	54.46	22.3
5.	E (30%FA+70%Soil+NPK+GH)	327	4478.3	57.00	21.4

Here, NPK= Nitrogen: Phosphorus: Potassium, FA= Fly Ash, GH= Growth Hormones (IAA+GA)

Result and discussion

The table 1 shows that the seed germination % of combination A has been recorded as 42% and it has increase up to 48% in combination B because of addition of NPK. In combination C it was increased up to 66% and in combination D it has increased up to 78% because of fly ash and NPK combination in soil but in combination E the maximum induction has been recorded of 99% has found because of sufficient amount of fly ash, NPK, IAA and GA.

Chlorophyll in fresh leaf of Peanut

In the fresh leaf chlorophyll a, chlorophyll b and total chlorophyll has been observed as 0.35, 0.29 and 0.64 mg gm^{-1} respectively. In the present work after 45 days chlorophyll has been estimated as 0.395 mg gm^{-1}, 0.489 mg gm^{-1} and 0.851mg gm^{-1}.

The value of chlorophyll a has observed minimum in 0.270 mg gm^{-1}, and maximum 0.395 mg gm^{-1} in the set A, B, C, D and E respectively, whereas for chlorophyll b the value has recorded as 0.400 mg gm^{-1}, 0.454 mg gm^{-1}, 0.460 mg gm^{-1}, 0.480 mg gm^{-1} and 0.489 mg gm^{-1} respectively. For total chlorophyll it was 0.670 mg gm^{-1}, 0.734 mg gm^{-1}, 0.760 mg gm^{-1}, 0.848 mg gm^{-1} and 0.851 mg gm^{-1} respectively.

In combination A, the number of leaves has been counted 243. The experiment shows that the leaves number has increased in other combinations in ascending order ranged (B-E) from (264-327)

respectively. In the combination E, number of leaves has been recorded maximum as compared to other combinations because of fly ash, micronutrients, NPK and IAA and GA. This is also due to the activation of the enzymes by IAA and GA (Gomathinayagam *et al.,* 2007). Fly ash is ameliorating the soil acidity and also providing essential trace element to soil for plant growth. The total leaf area of *Arachis hypogaea* indicates that the combination E has maximum leaf area 4476.3 cm² in compare to other combinations (table 2). The NPK provided nitrogen to leaves which is responsible for the leaf growth. Fly ash also increases the water holding capacity.

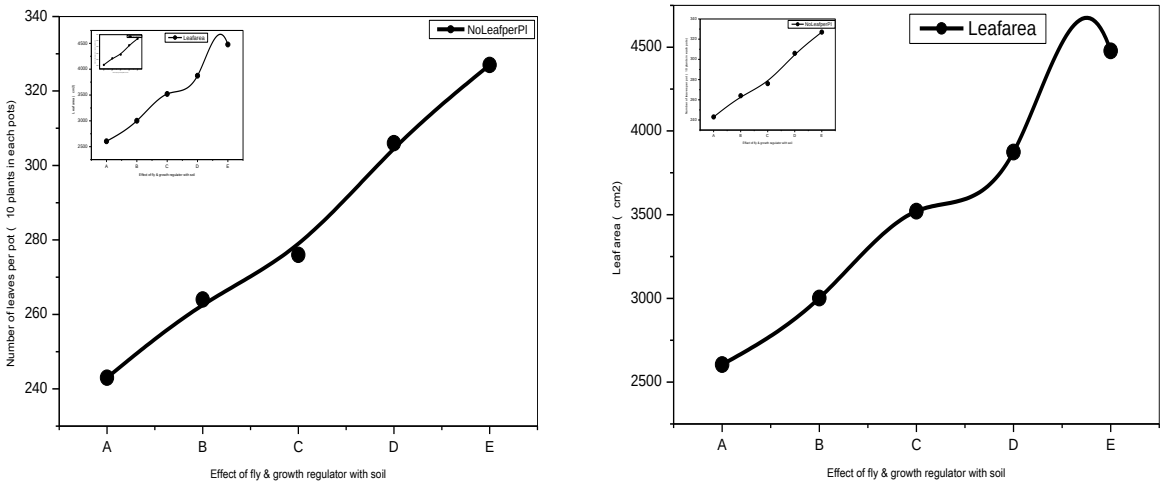

Fig. 1. Number of leaves per pot in different treatments.

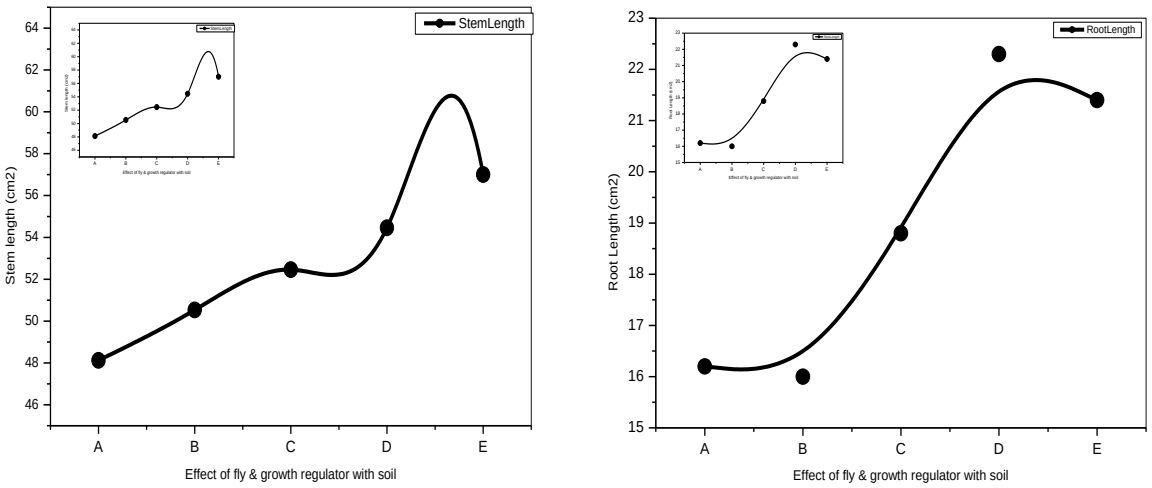

Fig. 3. The shoot length (cm2) in different treatments Fig 4 showing the trend in root length(cm2) in different treatmentsFig 2 representing trends in leaf area (cm2) in different treatments.

Present work representing the trend of uniform growth pattern i.e. Leaf area in cm2, number of leaves per plot, shoot length and root length with effect of fly ash and different parameter of growth regulator with soil in five different combinations (Graph 1-5). Fly ash also provided electrical conductivity in permissible limit (2.5 µ mhos). Growth regulator (IAA and GH) has induced the several enzymes for amino acid synthesis, cell division and cell elongation and results the increase in leaf area (Chang *et al.,* 2002). Result indicates that after 45 days in peanut the combination E again showed the maximum shoot and

root growth as 57 cm and 15.4 cm respectively and it was due to 70% soil, 30% fly ash, NPK (600:400:200) mg/pot, 1.42x10^{-5}m IAA and 6.42x10^{-5} m GA combination. Fly ash and NPK increased the trace element to the plant for root elongation. In the same type of experiment, Kaya *et al.,* 2006 has also indicated that the increments in gibberellic acid has affected the vegetative growth and pigment concentration and also improve the chlorophyll levels in maize at salinity stress in maize (Tuna *et al.,* 2008). These result suggested that plain soil could not contribute to chlorophyll formation.

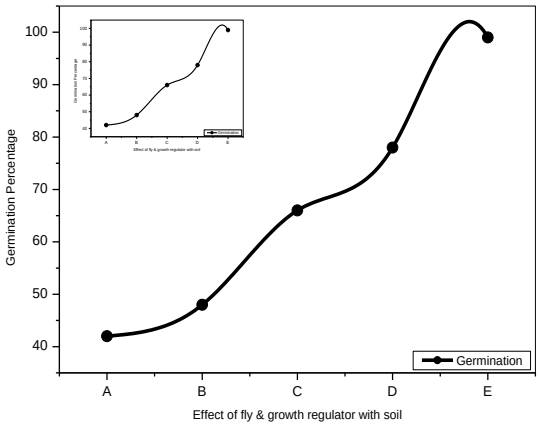

Fig. 5. The germination percentage in different treatments.

Fig. 6. Plain soil

Fig. 7. Plain soil +NPK (600:400:200) mg/pot

Fig. 8. Soil 90% + FA 10% + NPK (600:400:200) mg/pot

Fig 9: Soil 80% + FA20% + NPK (600:400:200) mg/pot

Fig. 10. Soil 70% + FA 30% + NPK (600:400:200) mg/pot + 1.42x10^{-5}m IAA + 6.42x10^{-5} m GA

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