Influence of fly ash seed pelleting on root rhizosphere populations of black gram and green gram

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ABSTRACT

Investigations were carried out to study the influence of flyash seed pelleting on microbial populations of bacteria, fungi, actinomycetes, and rhizobium in black gram and green gram. The experimental results revealed that seed pelleting with fly ash seed pelleting @ 250 g with rice gruel as adhesive increased rhizobium population in black gram and fungi and actinomyctes population in green gram by 10 to 15 %. Increased microbial activity will enrich soil microflora and in turn will be helpful in increasing the crop yield.

Key words: Flyash, Rhizosphere population, Seed pelleting.

INTRODUCTION

Black gram [Vigna mungo (L.) Hepper] and green gram [Vigna radiata (L.) Wilchek] are important food crops and good source of dietary proteins (Keatinge et al., 2011). They are suitable for cultivation under different farming situations, especially in marginal and rain fed areas. In any crop, seed is the basic input in agriculture to increase production and supply of quality seeds to the farmers is foremost to achieve the goal. Under rain fed conditions and in the case of small seeded crops like black gram and green gram, seed pelleting is one of the simplest and easiest methods to invigorate the seeds and improve seedling vigour, which in turn may reflect in enhancing yield.

In India, the fly ash production was 235 million tones in 2016 and is expected to reach about 1000 million tonnes per annum by 2031-32 (Virendra Kumar Yadav and Fulekar, 2018). The fly ash utilization in the country is estimated to be about 59% only (Kanungo, 2013). The flyash can be utilised in agriculture as seed pelleting material as 95 to 99 % of fly ash consists of oxides of Si, Al, Fe & Ca and about 0.5 to 3.5 % consists of Na, P, K & S and remained ash with trace elements. The concentration of nearly all elements present in flyash are higher than in soil except organic carbon and nitrogen. These nutrients present in the fly ash may be helpful in enhancing seed germination, seedling vigour and establishment when applied as seed pelleting material. Even though there are some reports on flyash seed pelleting on few crops viz., black gram (Prakash et al., 2012), bhendi (Prakash et al., 2014a), rice (Prakash et al., 2014b) and sesame (Prakash et al., 2014c), the effect of fly ash seed pelleting on rhizosphere population is very meagre. Hence, in the present study, an attempt was made to investigate the effect of flyash seed pelleting on rhizosphere populations in black gram and green gram.

MATERIALS AND METHODS

The experiments were conducted at the Plant Breeding Farm, Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, Annamalai Nagar (11°24’N latitude and 79°44’E longitude with an altitude of + 5.79 mts above mean sea level), Tamil nadu, India in two seasons viz., season 1 (S1) (January – April) and Season 2 (S2) (June – Sep) in 2017-2018. Genetically pure seeds of black gram (Vigna mungo) cv. ADT 3 and green gram cv. VBN 2 were graded for uniformity using appropriate round perforated metal sieves (BSS 7 x 7 wire mesh sieve) and imposed with pelleting treatments (as mentioned below) with flyash collected from Neyveli Lignite Corporation, Neyveli, Tamilnadu, India. Physiochemical properties of lignite flyash is as given below.

Physiochemical properties of lignite flyash.

| Parameters                  | Values |
|-----------------------------|--------|
| pH (1:2.5)                  | 10.0   |
| Electrical conductivity (25 m⁻¹) | 1.0 |
| Silica, SiO₂ (%)            | 2.1    |
| Alumina, Al₂O₃ (%)          | 49.0   |
| Iron, Fe₃O₄ (%)             | 11.3   |
| Calcium, CaO (%)           | 4.6    |
| Magnesium, MgO (%)         | 12.0   |
| Sulphate, SO₄ (%)          | 6.3    |
| Potash, K₂O (%)             | 7.1    |
| Carbon, C (%)              | 8.3    |
| Boron, hot water soluble (ppm) | 0.075|
| Water soluble silica, SiO₂ (ppm) | 2.0 |
| Available silica, SiO₂ (ppm) | 8.0 |
| Zinc (ppm)                 | 300    |
| Copper (ppm)               | 1258   |
| Manganese (ppm)            | 1078   |
| Nitrogen                   | Nil    |
| Phosphorus                 | Nil    |

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The experiment was carried out with the following pelleting treatments with two different types of adhesives i.e., the common adhesive, the gum @ 10 per cent (100 ml per kg of seed) and rice gruel. Gum arabic, also known as gum acacia, is a natural gum made of hardened sap taken from two species of the acacia tree; *Acacia senegal* and *Acacia seyal*. Rice gruel is a type of rice porridge popular in many Asian countries. It is recognised by its thick texture and due to its properties of glue and/or binder, it is used as an adhesive material in rural areas commonly. In pelleting treatment, the seeds were mixed with the common adhesives and were sprinkled with the flyash at various doses to seed and rolled for uniformity. The thickness of the seed coating is dependent on the amount of sticker in relation to the amount of seed. The total mixing time should not exceed four minutes (as per the standard procedure) since prolonged agitation may damage the seeds or chips of pelleted coat. The experiment was conducted in RBD with three replications in field with the following treatments.

T₀ – Control  
T₁ – Flyash pelleting @ 200 g with gum arabic @ 10 %.  
T₂ – Flyash pelleting @ 250 g with gum arabic @ 10 %.  
T₃ – Flyash pelleting @ 300 g with gum arabic @ 10 %.  
T₄ – Flyash pelleting @ 200 g with rice gruel.  
T₅ – Flyash pelleting @ 250 g with rice gruel.  
T₆ – Flyash pelleting @ 300 g with rice gruel.  

**Process of pelleting:**  
Seed  
↓  
Adhesive  
↓  
Filler (Flyash)

**Microbial assessment:** Top soil sample (0-15cm) adjacent to the crop rhizosphere were randomly collected using a core borer of 15 cm in depth and 5 cm in diameter during peak vegetative stage of the crop. The samples were initially transferred aseptically to the plastic bags that were labelled appropriately and then transported to the laboratory. In the laboratory, fractions of samples were immediately processed for microbial analysis. Culture experiments were conducted for enumeration of soil microbes with the specific recommended media used for the experiment as: a) Nutrient Agar for bacteria as described by Gordon *et al.* (1973), Rose Bengal Agar for fungi as described by Martin (1950) and Kenknights medium (KN) for actinomycetes as described by KenKnight and Muncie (1939). To estimate the number of soil microflora, counts were calculated on the basis of serial 10 fold dilution technique, using the pour plate methods and replicate of 10 gm soil samples and an appropriate dilution as described by Johnson and Curl (1972).

**RESULTS AND DISCUSSION**

The results obtained from flyash pelleting on microbial population in two different seasons in two crops viz., black gram and green gram were discussed here. From the study, it was found that 250 g flyash pelleting with rice gruel recorded higher bacterial population (8.33 X 10^6 cfu, 8.32 X 10^6 cfu) in black gram followed by 300 g flyash pelleting with rice gruel (8.24 X 10^6 cfu, 8.27 X 10^6 cfu), in both the seasons, whereas control had only 7.63 X 10^6 cfu, 7.67 X 10^6 cfu of bacterial population for both the seasons respectively (Table 1). Similarly, 250 g flyash pelleting with rice gruel recorded higher populations of fungi, actinomyctes and rhizobium in black gram in both seasons. Among the two seasons, populations of bacteria, fungi, actinomyctes and rhizobium were found higher in season I than season II. Among the microbial populations in root rhizosphere of green gram, higher populations of bacteria 9.10 X 10^6 cfu, 9.25 X 10^6 cfu), fungi (9.36 X 10^6 cfu, 9.63 X 10^6 cfu), actinomyctes (9.13 X 10^6 cfu, 9.26 X 10^6 cfu) and rhizobium (9.72 X 10^6 cfu, 9.62 X 10^6 cfu) were found in 250 g flyash pelleting with rice gruel in both seasons respectively and the lowest in control (Table 2). In general, in the first season, the microbial populations were higher when compared to second season. Similar reports of increased microbial population with fly ash application has been reported by Ramteke *et al.* (2017) in rice-wheat cropping system and Sheoran *et al.* (2014). These results might be due to the fact that applied organic sources were able to get mineralized rapidly and consequently provided sufficient nutrition for the proliferation of microbes and their activities in terms of

| **Table 1:** Effect of flyash seed pelleting on rhizosphere population in black gram. |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatment** | **Bacterial population**<br>(X 10^6 cfu) | **Fungi**<br>(X 10^6 cfu) | **Actinomyctes**<br>(X 10^6 cfu) | **Rhizobium**<br>(X 10^6 cfu) |
| | S₁ | S₂ | S₁ | S₂ | S₁ | S₂ | S₁ | S₂ |
| T₀ | 7.63 | 7.67 | 7.70 | 7.73 | 6.33 | 6.37 | 7.60 | 6.75 |
| T₁ | 7.93 | 8.07 | 8.40 | 7.95 | 6.53 | 6.57 | 7.70 | 6.92 |
| T₂ | 8.15 | 8.20 | 8.67 | 8.16 | 6.80 | 6.85 | 8.30 | 7.15 |
| T₃ | 8.12 | 8.20 | 8.47 | 8.26 | 6.67 | 6.58 | 8.13 | 7.23 |
| T₄ | 8.22 | 8.21 | 9.03 | 8.25 | 7.17 | 7.25 | 8.83 | 7.59 |
| T₅ | 8.33 | 8.32 | 9.10 | 8.73 | 7.33 | 7.53 | 9.17 | 7.98 |
| T₆ | 8.24 | 8.27 | 9.07 | 8.54 | 7.20 | 7.27 | 9.03 | 7.67 |
| CD(0.05) | 1.46 | 1.10 | 1.53 | 1.80 | 1.08 | 1.72 | 1.41 | 1.51 |

S₁ – Season 1 (January – April)  
S₂ – Season 2 (June – September).
Table 2: Effect of flyash seed pelleting on rhizosphere population in green gram.

| Treatment | Bacterial population (X 10^6 cfu) | Fungi (X 10^4 cfu) | Actinomycetes (X 10^4 cfu) | Rhizobium (X 10^6 cfu) |
|-----------|----------------------------------|-------------------|---------------------------|------------------------|
|           | S₁                               | S₂                | S₁                        | S₂                     | S₁                        | S₂                |
| T₀        | 8.36                             | 8.36              | 8.03                      | 8.35                   | 7.47                      | 7.57              |
| T₁        | 8.44                             | 8.49              | 8.51                      | 8.72                   | 8.41                      | 7.99              |
| T₂        | 8.86                             | 8.92              | 9.13                      | 9.10                   | 8.47                      | 9.83              |
| T₃        | 8.85                             | 8.83              | 9.06                      | 9.25                   | 8.27                      | 8.53              |
| T₄        | 8.96                             | 8.99              | 9.21                      | 9.37                   | 8.73                      | 8.92              |
| T₅        | 9.10                             | 9.25              | 9.36                      | 9.63                   | 9.13                      | 9.26              |
| T₆        | 9.01                             | 9.11              | 9.30                      | 9.45                   | 8.87                      | 9.13              |
| CD(0.05)  | 1.83                             | 0.89              | 1.16                      | 1.10                   | 1.35                      | 1.13              |
| S₁ – Season 1 (January – April) | S₂ – Season 2 (June – September) |

CONCLUSION

To conclude, seed pelleting with fly ash @ 250 g with rice gruel increased, microbial populations of rhizobium in black gram and fungi and actinomycetes in green gram.

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