

Original Research Article

Effect of enriched TSP polymer seed coating on germination physiology of greengram Var. CO8

Abstract

During 2022, the research was carried out under laboratory condition at the Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore, to find out the effect of TSP polymer seed coating on germination physiology of greengram. The seeds were coated with TSP polymer, TSP polymer with preservatives, TSP polymer with PGRs and TSP polymer with preservatives and PGRs @ 6 g/ kg of seeds. Among the various constituents of polymer, TSP polymer with preservative (0.1% sodium sorbate) and PGR (1.5 ppm BRs) performed better with good speed of germination and seedling vigour.

Keywords: TSP polymer, Sodium sorbate, GA₃, BRs

Introduction

Green gram (*Vigna radiata*) is third important pulse crop in the country after redgram and blackgram. Greengram is an excellent source of high-quality protein (25%), Riboflavin, Thiamine and vitamin C with high digestibility. Being a leguminous crop has capacity to fix the atmospheric nitrogen (30-40 kg N/ha). India is the major producer of green gram in the world, and it is grown in almost all the states. Greengram is mainly cultivated in rainfed condition in marginal lands mostly as an intercrop with less care and prone to number of disease and pest. ~~All together~~ Overall this causes hardship in maintaining population per unit area. Poor population lead to reduction in yield and might be the major cause for less productivity. There are a number of seed management techniques which augment the germination under a wide range of environmental conditions. ~~Through-through~~ which it is possible to maintain plant population per unit area there by chances for improving the yield ([Hassan et al., 2023a](#)).

Seed enhancement technique is the post-harvest treatment which helps to improve the germination and growth of seedlings (Taylor *et al.*, 1998, [Hassan et al., 2023 b](#)). Many shotgun approaches ~~are being~~ have been used for seed enhancement ~~for over~~ the last three decades, which include seed priming, seed pelleting, hardening, pregermination, magnetic

stimulation, film coating, encrusting etc. Seed coating refers to the application of nutrients, protectant and other ingredients to improve the performance of seed in all the environmental conditions (Ni, 1997, [Maan et al., 2021](#)). Polymer coating improves germination due to increase in the rate of imbibition where the fine particles in the coating act as a 'wick' or moisture attracting material which helps the seed to establish a good contact with soil. Due to their exceptional qualities, such as good coating and barrier performance, biodegradability, and low weight, natural or bio polymers or plant-based seed coating formulations are recommended as suitable for ~~continuous-continued~~ use ([Abdullah et al., 2023](#)). Biopolymer is a polymerized substance produced from natural resources, biological materials, or by living organisms. Superabsorbent hydrogels (SHs) made of polysaccharides have ~~hold promising prospects~~ shown promise as alternatives since they are biopolymers that are abundant in nature, nontoxic, typically inexpensive, and inherently biodegradable and biocompatible (Kamath and Par, 1993).

Tamarind seed polysaccharide (TSP) is a polysaccharide explored widely as a bioadhesive. It is a mucilaginous polysaccharide derived from the seed kernel of *Tamarindus indica* Linn. belongs to the family Fabaceae. Tamarind seed polysaccharide (TSP) based polymer is considered ideal for formulating immediate and sustained release of plant stimulants and protectant due to their high thermal and hemo stability, safety, non-toxic, hydrophilic and gel forming nature (Baveja, 1988; Joseph et al., 2012). Black gram seeds coated with TSP polymer (6g) + 0.3g humic acid + 0.2 g ascorbic acid + 0.5 ml of Zimmu leaf extract /kg performed better and ~~is the~~ recommended as presowing seed treatment ([Sivasakthiet al., 2022](#))

Plant Growth Regulators (PGRs) or phytohormones are defined as small, simple chemicals produced naturally by plants to regulate their growth and development. Among the phytohormones, GA₃ was studied abundantly for ~~their-its~~ biological role in plants and ~~is~~ referred to as cell elongation hormone (Jones et al., 1983, [Khalil et al., 2022](#)). GA₃ regulates germination by counteracting ABA in seeds.

Brassinosteroids (BRs) are a new type of polyhydroxy steroidal phytohormones with significant growth-promoting influence. It is essentially important for plant development and growth. BR signaling promotes cell expansion and cell division, and plays a role in etiolation and reproduction. BRs also exhibit synergistic effect with other phytohormones ~~such as-It~~

~~cross talk with~~ auxin, gibberellins, abscisic acid, ethylene, salicylic acid and jasmonic acid to promote plant growth and metabolism (Choudhary *et al.*, 2012).

~~Food preservatives are one of the most often consumed food additives. One of the highly consumed food additives is food preservatives.~~ Preservatives are used to increase the shelf life of foods by preventing microorganism growth ~~and to thereby~~ controlling food spoilage (Kefi *et al.*, 2022, Zhang *et al.*, 2021, Xylia *et al.*, 2022). Sorbate and benzoates are the most common preservatives that are used in a wide range of foods including mayonnaise and salad dressings (Amirpour *et al.*, 2015, Chaleshtori *et al.*, 2018). Sodium sorbate (E 201), which is the sodium salt of sorbic acid, is widely used as food preservatives on cheese, meat, ketchup, mayonnaise and marmalade ~~said by~~ (Potter 1984; Warth 1985). Revenli *et al.* and Nascimento (2019) reported that SMB (0.5% m/v) and combination of SMB (0.25% m/v) were the most effective in controlling the browning in processed tomato.

Comment [ZA1]: What is SMB?

Materials and Methods

The laboratory experiment was conducted at the Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore. Green gram seeds var. CO 8 ~~was were~~ procured from the Department of Pulses, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu. Tamarind seeds were procured from tamarind mandy at Coimbatore, Tamil Nadu.

Preparation of seed coating TSP polymer

TSP polymer was prepared according to Sivasakthi *et al.*, (2022) which served as basic ~~source outline~~ for other treatments. To improve the shelf life and to enrich the polymer ~~it was added with preservative and PGR~~ preservative was added alongside it. For enriching, five sets of 6 g of polymer were weighed. First set was added with 0.12 ml of 0.1 % Sodium sorbate which served as T₂, second set was added with 0.06 ml of 30 ppm GA₃, which served as T₃. Third set was added with 0.18 ml of 1.5 ppm BRs which served as T₄, Fourth set was added with 0.12 ml of 0.1 % Sodium sorbate + 0.06 ml of 30 ppm GA₃ which served as T₅, and final set was added with 0.12 ml of 0.1 % Sodium sorbate + 0.18 ml of 1.5 ppm BRs which served as T₆.

After ~~adding addition~~ of preservative and PGRs, for proper mixing, the polymer was stirred in a mechanical stirrer for 20 min then preserved for further use.

Seed treatment

From each treatments the required quantity of TSP polymer (6 g/kg of seeds) was weighed and dissolved in 15 ml of distilled water(Sivasakthi et al., 2022). After dissolving the polymer,the seeds were coated with respective treatments. ~~While coating, Care~~ was taken ~~for to ensure~~uniform coating. After coating the coated seeds were dried for 5 hours.

Treatment details

T₀- Absolute control

T₁ - TSP polymer 6 g/kg of seeds

T₂ - TSP polymer 6 g + 0.12 ml of 0.1 % Sodium sorbate

T₃ - TSP polymer 6 g + 0.06 ml Of 30 ppm GA₃

T₄ - TSP polymer 6 g + 0.18 ml of 1.5 ppm BRs

T₅ – TSP polymer 6 g + 0.12 ml of 0.1 % Sodium sorbate + 0.06 ml Of 30 ppm GA₃

T₆–TSP polymer 6 g + 0.12 ml Of 0.1 % Sodium sorbate + 0.18 ml of 1.5 ppm BRs

The coated seeds along with control were subjected to agermination study and the following observations viz., seed germination (%) (ISTA, 2013), speed of germination (Maguire, 1962), root and shoot length (Sivasakthi *et al.*, 2021), dry matter production (g seedlings⁻¹⁰) (ISTA, 2013) and vigour index II was computed using the following formula as per Abdul-Baki and Anderson, 1973.

Vigour index II = Germination (%) x Drymatter production (g seedling⁻¹⁰).

The data obtained were subjected to statistical analysis using Completely Randomized Block Design (CRD).

Result

The results revealed that the seeds coated with TSP polymer + Preservatives and PGRs showed significant difference for seed germination and seedling vigour. Among all the treatments maximum speed of germination was observed in T₄(25.05), it was on par with T₃ (24.98), T₆ (24.85), and T₅ (24.74). Though statistical difference was noticed for germination percentage, the numerical difference between treatments were minimum. It ranged from 90 (T₀) to 96 (T₄ and T₆) with mean of 94%. Treatments T₃, T₅ (95%) and T₄ and T₆(96%) were on par with each other; and control recorded significantly low germination which was on par with T₂ and T₃(93%).

Maximum root length was observed in T₆ (20.09 cm) it was on par with all treatments except T₀(16.79 cm). Maximum shoot length was observed in T₆ (21.40 cm) it was on par with T₅(21.31), T₄(21.04), T₃(20.85) and T₂(19.64) an T₁ (19.28).

Maximum dry matter production was observed in T₆ (0.193) followed by T₅(0.192), T₄ (0.191) and T₃ (0.189), all the treatments were on par with each other. Maximum vigour index was observed in T₆,T₅,T₄,T₃(18) and T₂ (17), It was on par with each other except T₀ (15) (Table 1).

Table 1 : Effect of seed coating with TSP Polymer + Preservatives and Plant growth regulators on seed germination physiology of greengram

Treatment	Speed of germination	Germination (%)	Root length (cm)	Shoot length (cm)	DMP (g seedlings ⁻¹⁰)	Vigour index II
T0	21.84	90	16.79	18.08	0.165	15
T1	22.72	93	17.93	19.28	0.177	16
T2	22.80	93	18.36	19.64	0.180	17
T3	24.98	95	19.56	20.85	0.189	18
T4	25.05	96	19.68	21.04	0.191	18
T5	24.74	95	19.95	21.31	0.192	18
T6	24.85	96	20.09	21.40	0.193	18
MEAN	23.85	94	18.17	19.46	0.177	17
SED	0.3387	1.0437	2.2631	2.4368	0.0222	2.0310
CD (0.05)	0.7044	2.1705	4.7064	5.0675	0.0461	4.2237

T₀- Absolute control, T₁-TSP polymer (6 g/kg of seeds), T₂-TSP polymer (6 g) + 0.12 ml of 0.1 % Sodium sorbate, T₃ - 0.06 ml of 30 ppm GA₃, T₄ -0.18 ml of 1.5 ppm BRs T₅ - 0.12 ml of 0.1 % Sodium sorbate + 0.06 ml of 30 ppm GA₃ and T₆ - 0.12 ml of 0.1 % Sodium sorbate + 0.18 ml of 1.5 ppm BRs

Discussion

High quality seeds play a major role in maximizing the productivity through assured rapid establishment under a wide range of environmental condition. Most of the species are sensitive to drought and water logging. The most affected stage is seed germination and seedling establishment. Seed germination can be augmented through various seed enhancement techniques. Among the number of seed enhancement techniques, seed coating is considered as one of the best. Because it augments the germination without modifying the physiological status of the seeds, whereas in other treatments like priming there was a threat of storing the seeds with good viability even for months.

In this present study greengram seeds coated with TSP polymer constituting preservative and plant growth regulator performed a little better than the control and TSP polymer alone coated seeds. Since in the study freshly harvested seeds with high germination percentage (90%) was used a jump in seedling character was not observed. The highest speed of germination is the indicator of high vigour. The speed of germination along with high germination percentage enables the seeds to establish faster and make the seedling to utilize the resource for further development and yield. The initial established vigour contributed a lot for yield and resultant seed quality. Dry matter production is an indicator of how tightly cells are packed in a tissue and number of cells, which contributes the biomass. In the present study seeds coated with T₆ and T₄ (96%) both showed high values for seed germination but considering all other factors viz., seedling length, dry matter production and vigour index T₆ excelled compared to T₄.

The reason for improvement in germination and vigour attributes may be due to availability of carbon source, from the TSP polymer and phytohormone Brassinosteroids (BRs). Tamarind seeds are rich in polysaccharide, contains about 65% of non fibre carbohydrates; many essential amino acids, like isoleucine, leucine, lysine, methionine, phenylalanine and valine. In addition to this, seeds are also good source of essential fatty acids, minerals particularly calcium, magnesium, phosphorous and potassium (Joseph *et al.*, 2012). BRs regulate root meristem size and lateral root development in a concentration-dependent manner. A low concentration of BRs promotes root growth, whereas a high concentration of BRs inhibit root growth (Gupta *et al.*, 2015; Lee *et al.*, 2015). In the present study, besides improving root

length, a network of roots are visualized in T₆ (figure 1). The secondary roots may help the plants to absorb soil nutrients and contribute ~~for~~in better establishment, growth and yield.



T₀ - Absolute control

T₆ – TSP polymer (6g) +
0.18 ml of 0.15 ppm
Brassinosteroid + 0.12 ml
of 0.15 % sodium sorbate

Fig 1 : A net work of roots are visualized in T₆

Conclusion

Coating of seeds with TSP polymer (6g) + 0.18 ml of 0.15 ppm Brassinosteroid + 0.12 ml of 0.15 % sodium sorbate had a positive effect on seed germination and seedling vigour of greengram. It notably improves the seedling efficiency, qualitatively and quantitatively and also additionally substitutes the synthetic polymers, that which, in turn, s helps in reduction of environmental pollution.

Reference

Comment [ZA2]: Arrange the reference alphabetically

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