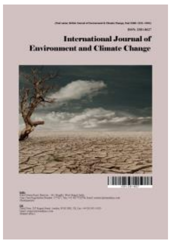

International Journal of Environment and Climate Change

Volume 13, Issue 10, Page 1495-1500, 2023; Article no.IJECC.105503
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Effect of Enriched TSP Polymer Seed Coating on Germination Physiology of Greengram Var. CO8

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2023/v13i102805

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/105503

Original Research Article

Received: 20/06/2023
Accepted: 25/08/2023
Published: 28/08/2023

ABSTRACT

During 2023, 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 green gram. 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.

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Keywords: TSP polymer; Sodium sorbate; GA_3; BRs.

1. INTRODUCTION

Green gram (*Vigna radiata*) is third important pulse crop in the country after redgram and black gram. Green gram 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. Green gram is mainly cultivated in rainfed condition in marginal lands mostly as an intercrop with less care and prone to number of disease and pest. 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 number of seed management techniques which augment the germination under a wide range of environmental conditions, through which it is possible to maintain plant population per unit area there by chances for improving the yield [1].

Seed enhancement technique is the post-harvest treatment which helps to improve the germination and growth of seedlings [2,3]. Many shotgun approaches have been used for seed enhancement over the last three decades, which include seed priming, seed pelleting, hardening, pre germination, 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), [4]. 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 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 for continued use [5]. Biopolymer is a polymerized substance produced from natural resources, biological materials, or by living organisms. Super absorbent hydrogels (SHs) made of polysaccharides have hold promising prospects as alternatives since they are biopolymers that are abundant in nature, nontoxic, typically inexpensive, and inherently biodegradable and biocompatible [6].

Tamarind seed polysaccharide (TSP) is a polysaccharide explored widely as a bio adhesive. It is a mucilaginous polysaccharide derived from the seed kernals 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 [7,8]. Black gram seeds coated with TSP polymer (6 g) + 0.3 g humic acid + 0.2 g ascorbic acid + 0.5 ml of Zimmu leaf extract /kg performed better and is the recommended pre sowing seed treatment [9].

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 its biological role in plants and is referred to as cell elongation hormone [10,11]. GA_3 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 signalling promotes cell expansion and cell division, and plays a role in etiolation and reproduction. BRs also exhibit synergistic effect with other phytohormones, such as auxin, gibberellins, abscisic acid, ethylene, salicylic acid and jasmonic acid to promote plant growth and metabolism [12].

Food preservatives are one of the most often consume food additives. Preservatives are used to increase the shelf life of foods by preventing microorganism growth thereby controlling food spoilage [13,14,15]. Sorbate and benzoates are the most common preservatives that are used in a wide range of foods including mayonnaise and salad dressings [16,17]. Sodium sorbate (E 201), which is the sodium salt or sorbic acid, is widely used as food preservatives on cheese, meat, ketchup, mayonnaise and marmalade [18,19]. Revenli fornana and Nascimento [20] reported that Sodium metabisulfite (0.5% m/v) and combination of Sodium metabisulfite (0.25% m/v) were the most effective in the controlling the browning in processed tomato.

2. 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 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.

2.1 Preparation of Seed Coating TSP Polymer

TSP polymer was prepared according to Sivasakthi et al., [21] which served as basic outline for other treatments. To improve the shelf life and to enrich the polymer Preservative PGR 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 T_2, second set was added with 0.06 ml 0f 30 ppm GA_3, which served as T_3. Third set was added with 0.18 ml of 1.5 ppm BRs which served as T_4, Fourth set was added with 0.12 ml of 0.1% Sodium sorbate + 0.06 ml 0f 30 ppm GA_3 which served as T_5, 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 T_6.

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

2.2 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 [21]. After dissolving the polymer, the seeds were coated with respective treatments. Care was taken to ensure for uniform coating. After coating the coated seeds were dried for 5 hours.

2.3 Treatment Details

T_0 - Absolute control
T_1 - TSP polymer 6 g/kg of seeds
T_2 - TSP polymer 6 g + 0.12 ml of 0.1% Sodium sorbate
T_3 - TSP polymer 6 g + 0.06 ml 0f 30 ppm GA_3
T_4 - TSP polymer 6 g + 0.18 ml of 1.5 ppm BRs
T_5 – TSP polymer 6 g + 0.12 ml of 0.1% Sodium sorbate + 0.06 ml 0f 30 ppm GA_3
T_6 – TSP polymer 6 g + 0.12 ml 0f 0.1% Sodium sorbate + 0.18 ml of 1.5 ppm BRs

The coated seeds along with control were subjected to a germination study and the following observations viz., seed germination (%) [22], speed of germination [23], root and shoot length [9], dry matter production (g seedlings^{-10}) [22] and vigour index II was computed using the following formula as per Abdul-Baki and Anderson, [24].

Vigour index II = Germination (%) x Dry matter production (g seedling^{-10}).

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

3. RESULTS

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 T_4 (25.05), it was on par with T_3 (24.98), T_6 (24.85), and T_5 (24.74). Though statistical difference was noticed for germination percentage, the numerical difference between treatments were minimum. It ranged from 90 (T_0) to 96 (T_4 and T_6) with mean of 94%. Treatments T_3, T_5 (95%) and T_4 and T_6 (96%) were on par with each other; and control recorded significantly low germination which was on par with T_2 and T_3 (93%).

Maximum root length was observed in T_6 (20.09 cm) it was on par with all treatments except T_0 (16.79 cm). Maximum shoot length was observed in T_6 (21.40 cm) it was on par with T_5 (21.31), T_4 (21.04), T_3 (20.85), T_2 (19.64) and T_1 (19.28).

Maximum dry matter production was observed in T_6 (0.193) followed by T_5(0.192), T_4 (0.191) and T_3 (0.189) it was on par with each other. Minimum dry matter production was observed in T_0 (0.165). Maximum vigour index was observed in T_6 (19) followed by T_5, T_4, and T_3 (18) it was on par with each other. Minimum vigour was observed in T_0 (15) (Table 1).

4. 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 augumented 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 treatment like priming there was a risk of storing the seeds with good viability, even for months.

In this present study green gram seeds coated with TSP polymer constituting preservative and plant growth regulator performed slightly better than the control and TSP polymer alone coated seeds. Since in the study freshly harvested seeds with high germination percentage (90%) were 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 develop 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 constitutes the biomass. In the present study seeds coated with T_6 and T_4 (96%) both showed high values for seed germination but considering all other factors viz., seedling length, dry matter production and vigour index T_6 excelled compared to T_4.

The reason for improvement in germination and vigour attributes may be due to availability of carbon source, from the TSP polymer and phytoharmone Brassinosteroids (BRs). Tamarind seeds are rich in polysaccharide, contains about 65% of non-fibre carbohydrates; many essential amino acids, like isoleusine, leusine, lycine, methionine, phenylalanine and valine. In addition to this, seeds are also good source of essential fatty acids, minerals particularly calcium, magnesium, phosphorous and potassium [25]. 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 [26], (Lee et al*.,* 2015). In the present study, besides improving root length, a network of roots are visualized in T_6 (Fig. 1). The secondary roots may help the plants to absorb soil nutrients and contribute in better establishment, growth and yield.

T_0 - Absolute control

T_6 – TSP polymer (6g) + 0.12 ml of 0.15 %of sodium sorbate + 0.18 ml of 1.5 ppm of brassinosteroid

Fig. 1. A network of roots are visualized in T_6

Table 1, Effect of seed coating with TSP polymer + preservatives and plant growth regulators on seed germination physiology of green gram

Treatment	Speed of germination	Germination (%)	Root length (cm)	Shoot length (cm)	DMP (g seedlings-^{10})	Vigour index II
T_0	21.84	90	16.79	18.08	0.165	15
T_1	22.72	93	17.93	19.28	0.177	16
T_2	22.80	93	18.36	19.64	0.180	17
T_3	24.98	95	19.56	20.85	0.189	18
T_4	25.05	96	19.68	21.04	0.191	18
T_5	24.74	95	19.95	21.31	0.192	18
T_6	24.85	96	20.09	21.40	0.193	19
MEAN	**23.85**	**94**	**18.17**	**19.46**	**0.177**	**17**
SED	0.338	1.043	2.263	2.436	0.022	2.031
CD (0.05)	0.704	2.170	4.706	5.067	0.046	4.223

T_o- Absolute control, T_1-TSP polymer (6 g/kg of seeds), T_2-TSP polymer (6 g) + 0.12 ml of 0.1 % Sodium sorbate, T_3 - 0.06 ml of 30 ppm GA_3 , T_4 - 0.18 ml of 1.5 ppm BRs T_5 - 0.12 ml of 0.1 % Sodium sorbate + 0.06 ml of 30 ppm GA_3 and T_6 - 0.12 ml of 0.1 % Sodium sorbate + 0.18 ml of 0.15 ppm BRs

5. CONCLUSION

Coating of seeds with TSP polymer (6 g) + 0.18 ml of 1.5 ppm Brassinosteroid + 0.12 ml of 0.15% Sodium sorbate had a positive effect on seed germination and seedling vigour of greengram. It notably improved the seedling efficiency, qualitatively and quantitatively and additionally substitutes the synthetic polymers, which, in turns, helps in reduction of environmental pollution.

ACKNOWLEDGEMENT

The authors wish to thank the Department of Science and Technology (DST), and Green grow agritech, Thiruvannamalai, For their Fellowship.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/105503