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Seed Pelleting Technique for Mechanized Sowing in Green Gram [*Vigna radiata* (L.) R. Wilczek]

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ABSTRACT

Background: Now-a-days, use of machines is becoming important due to shortage of labour for field operations. One such case is seed drill sowing which warranted enough seed size for easy sowing. Pelleting of seed is one of the techniques through which the size of the seed can be increased thereby it can be sown easily by seed drill. Green gram is one of the important pulses which needs pelleting technique for mechanized sowing.

Methods: The experiments on standardization of seed pelleting technique and evaluating under field conditions were conducted in the Department of Seed Science and Technology, Seed Centre, Tamil Nadu Agricultural University, Coimbatore, India during 2019-2022. The green gram var. CO 8 seeds were primed and pelleted with TNAU pelleting mixture. Then, the pelleted seeds were sown by pneumatic seed drill and evaluated for its field performance.

Result: The results showed that the green gram seeds primed with $MnSO_4$ @ 0.5% and pelleted with 7 layers of TNAU pelleting mixture along with imidacloprid 70 WS @ 7 g/kg have recorded increased seedling vigour without affecting the seed germination. Also, the seeds sown by seed drill have recorded with better plant growth traits and higher yield. Also, single seed placement was achieved by seed drill sowing and about 25% seeds can be saved.

Key words: Field performance, Green gram, Seed drill sowing, Seed germination, Seed pelleting, Seedling vigour.

INTRODUCTION

Green gram [*Vigna radiata* (L.) R. Wilczek] is an important pulse believed to be originated from India. India contributes more than 70% of world's greengram production. During 2021-22, about 35.25 lakh ha area was covered under greengram and 28.50 lakh tonnes were produced. Green gram contains richest plant-based sources of protein. Also, its grain contains essential amino acids such as phenylalanine, leucine, isoleucine, valine, lysine and arginine. The crop is being cultivated mostly under rainfed condition and also in irrigated situation.

Since the crop growth is short in nature and matures in short duration, it is sown in closer spacing. Also, sowing alone needs more labour and handling of small seeds during sowing requires more man power. Thus, the mechanical sowing with seed drill is warranted and it needs standardization of the procedures. Seed quality enhancement techniques are important which essentially required for better establishment of the crop. In such a case, seed priming and pelleting techniques are being followed as the better seed quality enhancement practices.

Seed priming is an important pre-sowing seed treatment, which act as boon to dry land farming which shows the prominent effect in seed and seedling quality (Gunasekar *et al*., 2017). It also paves the way to overcome adverse environmental conditions like low rainfall and seedling establishment. It reduced the seed mortality, increased crop production which leads to enhance the yield potential. Maurya *et al*. (2020) stated that seed priming is a promising option to improve seed germination, seedling emergence and plant stand for achieving self-sufficiency in pulse production and therefore better availability for balanced diet for poor population of India.

Seed pelleting is also another pre-sowing seed treatment which is done by enfolding the seed with any foreign material which provides the uniform size and weight to seeds. In simpler terms, stamping of seeds with adhesive and coating with filler materials and rolling to get uniformity and finally pelleted seeds are shade dried. This is mainly done to improve the size of the seed for mechanized sowing

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and helps for increasing the vigour of seedling which is important factor in crop production (Mandal *et al*., 2015). The success of the pelleting depends on the filter material used for pelleting of seeds. Seed pelleting improved the root and shoot growth through which it increased the yield (Prakash *et al*., 2013). In Indian prospects the major constraints in pulse production are their low production and productivity. Thus, seed pelleting has vast potential to overcome these issues because of above stated advantages (Khanna *et al*., 2022).

A proper placement of seed in field is most important operation in order to obtain optimum yield of crop. Panning *et al*. (2000) investigated the performance of the seed-metering device of a pneumatic planter under laboratory and field conditions at disc speeds of 0.25 to 0.33 ms^{-1} peripheral velocity with disc hole diameter of 2.5 to 3.5 mm and an operating vacuum pressure of 3 kPa, to optimize the design and operating parameters for cotton seed planting. The effect of operational speed of the disc, vacuum pressure and shape of the entry of seed hole were evaluated by examining the mean seed spacing, precision in spacing (coefficient of variation), miss index, multiple index and highest quality of feed index. The pneumatic planter was found suitable for sorghum with the best suited gear combination. Performance of the pneumatic planter was evaluated in the field and the average values of plant to plant spacing, mean miss index and multiple index, actual field capacity and field efficiency were found to be 101 mm, 2.07%, 3.8%, 0.77 ha/h, 79.7%, respectively (Ranjeet Kumar *et al*., 2015).

Therefore, the experiments were conducted to standardize the method of seed encapsulation or otherwise called pelleting for green gram seeds and to evaluate the encapsulated seed through seed drill sowing under field condition.

MATERIALS AND METHODS

The experiments were conducted in the Department of Seed Science and Technology, Seed Centre, Tamil Nadu Agricultural University, Coimbatore, India during 2019-2022. The green gram var. CO 8 seeds were pelleted with TNAU pelleting mixture with different layers *viz*., 7, 8 and 9 using gum arabic as adhesive. Subsequently, the pellets were shade dried. Then, the pelleted seeds were evaluated for its germination (ISTA, 2013) and seedling vigour parameters. The physical traits of the pellets were also recorded. Based on the physical traits and seedling vigour, it has been standardized that the pelleting of seeds with 7 layers of TNAU pelleting mixture as optimum for green gram.

After standardization, the seeds were primed with $MnSO_4$ @ 0.5% by soaking for 3 h as per the recommended practice and dried back to the original moisture content. Then, the primed seeds were pelleted with TNAU pelleting mixture by 7 layers along with different constituents as per the treatment schedule *viz*., T_0-Control, T_1-Seed pelleting with TNAU pellet mixture (7 layers), T_2-Seed priming followed by pelleting with TNAU pellet mixture, T_3- Seed priming followed by pelleting with TNAU pellet mixture and carbendazim 50 WP @ 2 g/kg, T_4- Seed priming followed by pelleting with TNAU pellet mixture and imidacloprid 70 WS @ 7 g/kg, T_5- Seed priming followed by pelleting with TNAU pellet mixture and carbendazim 50 WP @ 2 g/kg and imidacloprid 70 WS @ 7 g/kg, T_6- Seed priming followed by pelleting with TNAU pellet mixture and biochar @ 5g/kg, T_7-Seed priming followed by pelleting with TNAU pellet mixture and vermicompost @ 12 g/kg. Afterwards, the pelleted seeds were dried under shade. The seed germination and seedling vigour of the primed and pelleted seeds were evaluated by adopting completely randomized design in three replications.

Based on the results, the standardized treatment along with control were sown in the field to assess the field performance and crop productivity at different locations *viz*., Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore; Agricultural Engineering College and Research Institute, Kumulur and Krishi Vigyan Kendra, Aruppukottai. The treatments are T_1-Control, T_2- Seed priming with 0.5% $MnSO_4$ and T_3- Seed priming with 0.5% $MnSO_4$ followed by pelleting with TNAU pellet mixture and imidacloprid 70 WP @ 7 g/kg. The pelleted and un-pelleted seeds were sown in 30 × 10 cm spacing by using tractor drawn pneumatic seed drill. The experiment was conducted in eight replications using randomized block design in all the locations. Then, the recommended cultivation practices were followed uniformly in all the centres. The experiment was conducted for two seasons in all the centres. The plant growth and yield parameters were observed and the pooled data collected from different centres were analysed.

The data collected were subjected to statistical analysis (Panse and Sukhatme, 1967) and the critical difference values were calculated at 5% probability level.

RESULTS AND DISCUSSION

The results showed that the green gram seeds pelleted with different layers have showed differences in their physical properties. Generally, the weight of the seed was increased along with diameter. The seeds pelleted with TNAU pelleting mixture with 7, 8 and 9 layers were recorded 99.8, 133.9 and 163.7% increase in weight respectively. Similarly, the seed diameter was increased from 3.80 mm to 5.60, 6.40 and 6.80 mm diameter due to pelleting of seed. In which, percentage of the broken pellets was less in 7 layers and it took lesser time to dissolve in water (6 h 20 min) (Table 1). Also, the seeds pelleted with 7 layers of TNAU pelleting mixture were found suitable for better germination and seedling vigour (Table 2).

Consequently, the seeds were primed with $MnSO_4$ @ 0.5% as per the recommendation and pelleted with 7 layers of pelleting mixture along with different constituents. In which, the seeds primed with $MnSO_4$ @ 0.5% and pelleted with 7 layers of TNAU pelleting mixture along with imidacloprid 70 WS @ 7 g/kg (T_4) have recorded increased vigour without

affecting the seed germination both under laboratory and field conditions (Table 3). Speed of germination (11.18) and germination (100%) were higher in the seeds primed with $MnSO_4$ @ 0.5% and pelleted with 7 layers of TNAU pelleting mixture along with imidacloprid 70 WS @ 7 g/kg. Also, it has recorded higher shoot length (11.18 cm), root length (17.82 cm) and seedling dry matter production (0.255 g/10 seedlings) when compared with unpelleted seeds which recorded lesser shoot length (10.91 cm), root length (11.38 cm) and seedling dry matter production (0.192 g/10 seedlings). Generally, seed priming increases the speed and uniformity of germination (Heydecker and Coolbear, 1977). Activation of preformed enzymes in providing vigour seems putative (Sivasubramaniam *et al*., 2011). In addition, seed priming act as good tool to improve the metabolic activity which results in quicker germination (Renugadevi and Vijayageetha, 2006). Similarly, Aryal *et al*. (2020) found that the black gram seed priming with PEG @ 2% showed a better overall germination parameters and seedling characteristics indicating higher seedling vigour.

In the present study, the added growth promoting substances in TNAU pelleting mixture facilitates nutrition, invigoration and protection to the seeds so as to enhance the better germination and seedling vigour where the seeds

Table 1: Effect of different layer of pelleting on seed physical properties in green gram.

Treatments	100 seed/ pellet wt. (g)	Seed wt. increase (%)	Seed/pellet diameter (mm)	Good pellets (%)	Broken pellets (%)	Dissolution time (h/min)
T_0- Control (unpelleted)	3.39	-	3.80	-	-	-
T_1- Seed pelleting with TNAU pellet mixture (7 layers)	6.77	99.8	5.60	90.5	9.05	6/20
T_2- Seed pelleting with TNAU pellet mixture (8 layers)	7.93	133.9	6.40	88.7	11.16	6/55
T_3- Seed pelleting with TNAU pellet mixture (9 layers)	8.94	163.7	6.80	88.7	10.98	7/15

Table 2: Effect of different layer of pelleting on seed germination and seedling vigour in green gram.

Treatments	Germination (%)	Shoot length (cm)	Root length (cm)	DMP (g/10 seedlings)
T_0- Control (Unpelleted)	92	9.15	7.80	0.160
T_1- Seed pelleting with TNAU pellet mixture (7 layers)	96	9.20	9.40	0.158
T_2- Seed pelleting with TNAU pellet mixture (8 layers)	95	9.05	9.40	0.166
T_3- Seed pelleting with TNAU pellet mixture (9 layers)	95	9.25	10.30	0.151
SEd	1.60	0.09	0.10	0.01
CD (p=0.05%)	NS	NS	0.20	NS

Table 3: Effect of priming and pelleting with additives on seed germination and vigour in green gram.

Treatments	Speed of germination	Germination (%)	Field emergence (%)	Shoot length (cm)	Root length (cm)	DMP (g/10 seedlings)
T_0- Control	8.74	97	88	10.91	11.38	0.192
T_1- Seed pelleting with TNAU pellet mixture (7 layers)	10.00	100	92	10.85	14.52	0.270
T_2- Seed priming + pelleting	10.73	100	100	9.93	13.30	0.229
T_3- Seed priming + pelleting + carbendazim 50 WP @ 2 g/kg	11.05	99	92	10.05	15.10	0.228
T_4- Seed priming + pelleting + imidacloprid 70 WS @ 7 g/kg	11.18	100	92	11.18	17.82	0.255
T_5- Seed priming + pelleting + carbendazim 50 WP @ 2 g/kg + imidacloprid @ 7 g/kg	10.72	99	91	10.17	13.02	0.228
T_6- Seed priming + pelleting + biochar @ 5 g/kg	11.47	99	96	10.09	17.93	0.213
T_7- Seed priming + pelleting + vermicompost @ 12 g/kg	10.64	99	91	10.42	15.14	0.210
SEd	0.14	0.90	2.90	0.17	0.71	0.01
CD (p=0.05%)	0.30	NS	6.20	0.35	1.50	0.02

Table 4: Pooled data showing the effect of pelleted seed sown by seed drill on plant growth and yield in green gram.

Treatments	Field emergence (%)	Plant population (m^2) (30 DAS)	Plant height (cm)	Days to 50% flowering	Days to maturity	No. of pods/ plant	Seed yield (kg/ plot 20 m^2)	Seed yield (kg/ha)
T_1- Control	85.4	24.0	46.6	37	62	32.4	1.6	816
T_2 - Seed priming with 0.5% $MnSO_4$	89.1	27.5	49.3	36	61	36.5	1.7	862
T_3- Seed priming with 0.5% $MnSO_4$ followed by pelleting with TNAU pellet mixture along with imidacloprid 70 WP @ 7 g/kg	89.1	28.4	51.3	39	63	39.5	1.8	897
SEd	0.07	0.13	0.08	0.50	0.48	0.19	0.02	2.51
CD (p=0.05%)	0.15	0.28	0.18	1.08	1.04	0.40	0.05	5.39

primed with $MnSO_4$ @ 0.5% and pelleted with 7 layers of TNAU pelleting mixture along with imidacloprid 70 WS @ 7 g/kg. Similar results were also observed in earlier studies (Anbarasan *et al*., 2016; Singh *et al*., 2018). Also, seed pelleting provides effectiveness in stimulating growth substances and avoids wastage of materials on broadcasting or soil application (Scott, 1989). Khanna *et al*. (2022) opined that seed pelleting is the process in which inert materials are added to seed with an objective to improve seed placement, germination and crop stand and to reduce seed rate and to impart protection against various biotic and abiotic stresses specially in case of pulses as few of them have very small seeds which are difficult to handle. The seed weight increases for different coating methods varies with coating technology and it provides a delivery system for many other materials including biostimulants, nutrients and plant protectants (Afzal *el al*., 2020). Jeephet *et al*. (2022) found that the pelleting of lettuce seeds with $CaSO_4$-zeolite (30 g of $CaSO_4$, 100 g of zeolite) using carboxymethyl cellulose (0.4% w/w aqueous) was the most appropriated formula for increasing germination and seedling vigour. As a result, to make seed pelleting successful, it is necessary to learn the physical properties of the seeds and their quality after being pelleted to confirm the complete results of seed pelleting formula development (Siri, 2015).

Thus, the field trials conducted at different locations in two seasons showed that the green gram var. CO 8 seeds primed with $MnSO_4$ @ 0.5% and pelleted with TNAU pelleting mixture along with imidacloprid 70 WS @ 7 g/kg and sown by pneumatic seed drill have recorded better plant growth and yield parameters (Table 4). In which, maximum plant population (28.4/m^2) and plant height (51.3 cm) were recorded in the seeds primed with $MnSO_4$ @ 0.5% and pelleted with TNAU pelleting mixture along with imidacloprid 70 WS @ 7 g/kg and sown by seed drill. Days to 50% flowering and maturity were also showed little earlier in this treatment when compared to control. The number of pods per plant (39.5) and yield (897 kg/ha) were higher in the seeds primed with $MnSO_4$ @ 0.5% and pelleted with TNAU pelleting mixture along with imidacloprid 70 WS @ 7 g/kg and sown by seed drill compared to control. The single seed placement was recorded with the increase in seed size and sowing with pneumatic seed drill. In addition, the seed rate has been reduced about 25% due to single seed placement by the seed drill machine. Therefore, the wastage of seeds can be avoided. In addition, labourer saving in terms of avoiding of thinning operation to remove excess plants in the field would be achieved.

Support to the present findings, Dogan and Zeybek (2009) found that seed pelleting was effective in sowing sesame seed and it significantly enhanced plant height, lateral branches and number of capsules per plant as compared to non-pelleted seeds. Chemical and biological seed treatments and coatings have the potential to ameliorate deleterious effects of transient abiotic stress, pest and disease incidences (Sharma *et al*., 2015; Chandrika *et al*., 2019; Raja *et al*., 2019a; Raja *et al*., 2019b). Similarly, Wasanthika *et al*. (2022) studied that the pelleted sesame seeds sown using seeders enabled successful crop establishment and yield performances compared to other treatments. Pelleting or priming the groundnut seed with a Ca compound significantly reduced seedling mortality. Also, pelleting groundnut seed with Ca enhanced earlier emergence and plant growth. The most effective Ca compound was $CaSO_4$ among the priming treatments, whereas $CaCO_3$ was the most effective among the pelleting treatments to reduce seedling mortality (Murata *et al*., 2008). Thus, the seed priming with $MnSO_4$ and pelleting with nutrients added TNAU pelleting mixture might have supported the plant system for better establishment, growth and yield of the plant. Also, added chemical insecticide imidacloprid 70 WS @ 7 g/kg would have helped the plant system to escape the earlier pest population thereby better plant growth in the field conditions.

CONCLUSION

It is concluded that the green gram var. CO 8 seeds primed with $MnSO_4$ @ 0.5% and pelleted with TNAU pelleting mixture along with imidacloprid 70 WS @ 7 g/kg and sown by seed drill have recorded with vigourous seedlings, better field emergence, optimum plant population and higher yield. Also, single seed placement was achieved by

pneumatic seed drill sowing. In addition, about 25% seeds can be saved due to the pelleted seed sowing by tractor drawn pneumatic seed drill.

Conflict of interest

The authors declare that there is no conflict of interest.

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