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RESEARCH ARTICLE

Assessing efficiency of seed hardening treatments in blackgram

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SUMMARY

Seed is a biological entity and its quality is improved through seed hardening. Seed hardening is a simple method to alter the physiological and biochemical nature of the seeds. Any successful technology could be performed well in farmer field and their feedback will be helpful for fine tuning of the technology. On farm trial was conducted in farmers field with two seed hardening treatments *viz.*, (i) Seed hardening with Zinc sulphate @ 0.1g/lit for 3 hr and (ii) Seed hardening with Sodium molybdate @ 0.5g/lit for 3 hr along with untreated seeds as a control during *Rabi*, 2017-18. The results revealed that seed hardening with Sodium molybdate @ 0.5g/lit performed better interms of yield (678 kg/ha), net return (Rs.23,125/ ha) and benefit cost ratio (1.81) compared to seed hardening with Zinc sulphate @ 0.1g/lit and control and which was 669 kg/ha, Rs.21913/ha, 1.77 and 514 kg/ha, Rs.12159 /ha, 1.45, respectively. However, the minimum yield difference was observed between the seed hardening treatments but both seed hardening treatment were excelled over the control. Hence, seed hardening with Sodium molybdate @ 0.5g/lit or Zinc sulphate @ 0.1g/lit for 3 hr found effective in increasing the yield in blackgram. The knowledge level of farmers on seed hardening treatments increased from 13 to 70 per cent which was made through on farm testing programme.

Key Words : Seed hardening, Blackgram, Knowledge index

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Seed is a biological entity and good quality seeds are playing vital role in enhancing the yield potential any filed crops. The low productivity in blackgram under rainfed condition is mainly associated with use of poor quality seeds, soil moisture deficit, low and erratic rainfall and improper crop management. The most common impediment faced by the Indian farmer is the failure of monsoon, which in its extreme manifestation is called drought. In some regions, erratic rainfall leads to drought during the vegetative phase upsetting the water balance of a plant and as a consequence, the physiological functions contributing to growth and yield are reduced.The moisture stress during early germination will affect the plant population and which reflects on

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low yield. Though, this largely depends on genetic makeup of the variety, pre-sowing treatments like hardening are also practiced to challenge the ill effects of drought on emergence and growth of the crop. Seed hardening technique has come a long way and modified to suit various needs as determined by environment (Henckel, 1964). Seed hardening is also known as wetting and drying, or hydration-dehydration refers to soaking in water and drying (Pen Aloza and Eira, 1993). Different physiologial activities within the seed occur in various moisture levels and the last physiological activity in the germination process is the emergence of radicle (Vertuciand Leopold, 1984 and Taylor, 1997).

For initiation of radicle emergence, high seed water content of upto 30% is required. Under limiting seed water content situations, all the metabolic steps necessary for germination can occur without the irreversible act of radicle emergence. After seed hardened, seed moisture content can be reduced by drying before radicle emergence. Then, hardened seeds can be stored for a short time prior to sowing. Among the several seed enhancement techniques, pre-sowing seed hardening is one of the best methods that results in modifying the physiological and biochemical nature of seed so as to modify characters that are favourable for drought resistance. Pre-sowing hardening is helps to activate extensive physiological reorganization induced by dehydration process. Generally, seed hardening can be done with water or bioactive chemicals/ growth regulating compounds or using commonly available natural tonics like coconut water or milk. Hardening induces early germination, better root and seedling growth, reduces seedling mortality, increases crop population and enhances the yield potential of the crop varieties. Hence, an attempt was made to check the performance of seed hardening treatments in blackgram through 'On farm testing' at farmers field.

MATERIAL AND METHODS

The prime mandate of Krishi Vigyan Kendra is to demonstrate the latest agricultural technologies through "On farm trials (OFTs) and Frontline demonstrations (FLDs)' to the farmers as well as the extension workers of the State Department of agriculture with a view to reduce the time lag between the technology generation and its adoption. The 'On farm trial' was conducted at fifteen locations in Kattallai' Village, Marakanam block of Villupuram district during 2018-19. The village was selected based on the Rural Appraisal method and cultivation practices of the Villupuram District during Rabi. Before conduct of OFT, the farmers were imparted with respect to seed hardening and other improved crop management practices through training programmes.

The blackgram seeds (VBN 6) were hardened with Sodium molybdate @ 0.5g/lit for 3 hr and Zinc sulphate @ 0.1g/lit for 3 hr and they were compared each other along with untreated. The critical inputs *viz,* blackgram seeds (VBN 6), Pulse wonder (TNAU Crop booster), IPDM components were distributed to the beneficiaries. Farmers were trained to follow the package and practices of blackgram cultivation as recommended by the Tamil Nadu Agricultural University. The KVK scientists periodically visited the OFT fields on different crop stages to ensure timely application of nutrients, weedicides and plant protection measures and also to offer other suggestive measures to the farmers and collect the feedback information on each stage for further improvement in research and extension programme. At end of the cropping stage, the yield data was assessed by adopting crop cutting method and the field day was conducted in collaboration with extension officials from Department of Agriculture to disseminate the improved technologies which were followed in OFT farmers to other fellow farmers. The relevant data regarding cost of cultivation, market preference, and other constraints were also collected through well designed interview schedule consisting of set of questions. The data on production and profitability of crop yield of OFT and control plots were collected from each farmer and averaged out in all locations. The collected information was grouped and tabular analysis was done for calculating the technological gap by using the suitable statistical tools.

Further, the knowledge level of OFT farmers with improved production technologies of blackgram before and after the interventions of KVK was measured by adopting knowledge test as suggested by Singh (1986). The various improved production technologies like selection of improved varieties, Integrated Nutrient Management (INM), foliar spray of crop boosters (Pulse Wonder, Integrated Pest and Disease Management (IPDM) were also selected and administrated to the respondents before and after implementation of the OFT programme.

According to Madhan (2002), the knowledge level was scored and given two marks for every correct answer and one mark for incorrect answer. The pre and

post evaluation scores were assessed and the knowledge level of the respondents was calculated as below.

The formula used for the calculation of knowledge index of each respondent was :

$$\text{Knowledge index} = \frac{K}{P} x100$$

where,

K - Knowledge scores obtained by an individual respondent

P - Maximum possible scores for all items

The respondents were classified into three categories such as low, medium and high using mean and standard deviation.

RESULTS AND DISCUSSION

The effectiveness of seed hardening treatments *viz.,*Sodium molybdate @ 0.5g/lit for 3 hr and Zinc sulphate @ 0.1g/lit for 3 hr of blackgram was assessed and demonstrated from seed to harvest in farmers field and its performance is detailed below.

The results revealed that the farmers achieved an average yield of 678 and 669 kg/ha in Sodium molybdate and Zinc sulphate hardened seeds, respectively wherein average yield of control was 514 kg/ha observed in check plot (Table 1). The yield difference of Sodium molybdate hardened seed to control was 164 kg/ha and the percentage of yield gap is 31.9. Similarly, field emergence and plant population were also excelled in Sodium molybdate hardened field.

The instrumental effects of seed hardening are primarily related to pre-enlargement of the embryo (Austin *et al*., 1969), biochemical changes like enzyme activation (Lee *et al*., 1998; Lee and Kim, 2000; Farooq *et al*., 2005) and improvement of germination rate (Lee *et al.*, 1998). Mathew *et al*. (2004) reported that the superiority of the seed hardening strategy in improving the various attributes such as speed of germination, germination percentage, and seedling vigor that facilitated crop establishment in the field under subdued soil moisture. The minimum seedling mortality with maximum seedling density was observed in treatments involving hardening. The yield increase might be due to significant increase in hydrophilic property of protoplasmic colloids namely viscosity and elasticity; increased mitochondrial phosphorylation, reduction in solute leakage by boosting cell membrane integrity, In the first period of imbibitions, resumption of rate of protein and RNA synthesis are characterized and shortening of the time of DNA replication in the second hydration period, stimulation of long lived mRNA under moisture stress conditions; simultaneous protein and proline content increase after hardening treatments and quenching of free radicals (Henckel, 1964).. Pre-sowing treatments also initiate the formation of vital biomolecules, enhance mitochondrial activity and preserve cellular ultrastructures which would allow plants to resist adverse edapho-climatic conditions. The significance of some of these cellular changes are claimed to include a more xeromorphic structure with higher rate of photosynthesis, lower rate of respiration, lower water deficit, the ability to hold a greater quantity of water and a more effective root system with higher root-shoot ratio and less yield reduction when subjected again to drought as compared to non-hardened plants (May *et al*., 1962).

The economic analysis of seed hardening treatments of blackgram was studied based on gross income which was calculated with average yield multiplied by prevailing market price of that particular year. It could be observed that the average net income of the Sodium molybdate was Rs. 23,125/- ha, which was Rs.21,913/- ha and

Table 1: Performance of seed hardening treatments in blackgram under OFT programme

Treatments	Field emergence (%)	Plant population (Nos)	Yield (kg/ha)	Yield gap (%)
Control	73	24	514	-
Seed hardening with Zinc sulphate @ 0.1g/lit	92	30	669	30.2
Seed hardening with Sodium molybdate @ 0.5g/lit	92	31	678	31.9

Table 2: Economic analysis of seed hardening treatments in blackgram

Treatments	Gross cost (Rs./ha)	Gross income (Rs./ha)	Net income (Rs./ha)	BCR
Control	39049	26890	12159	1.45
Seed hardening with Zinc sulphate @ 0.1g/lit	29328	49261	21913	1.77
Seed hardening with Sodium molybdate @ 0.5g/lit	28484	51609	23125	1.81

12159/- ha in Zinc sulphate and control plots, respectively. Further, the benefit cost ratio of the Sodium molybdate and Zinc sulphate hardened plots were1.81 and 1.77, respectively, whereas in the control, it was 1.45 (Table 2).

Knowledge is a pre-requisite for adoption of innovation and it would enable the farmers to completely understand a technology and its relative advantage. The knowledge level of farmers on associated effect of both seed hardening and other improved practices are must in assessing the successful dissemination of technology. Hence, an attempt was made to assess the knowledge before and after the interventions of KVK. The knowledge level of the blackgram farmers in improved technologies was medium (40 %) to low (35 %) in before implementation of the OFT programme (Table 3.). The knowledge level was increased from medium (50 %) to high (32%) after implementation of the programme. The appropriate reason for medium to higher level of knowledge on improved production technologies of blackgram might be due to the fact that KVK conducted the technical programme and extension activities such as training programmes, demonstrations and field day during OFT programme. Further, KVK played an important role in dissemination of technologies through distribution of relevant literatures during the extension activities.

It could be observed that, before implementation of the OFT programme, only around 13 per cent farmers had knowledge on seed hardening treatments and it was increased to 70 per cent after implementation of the OFT programme (Table 4). Similarly, 25 per cent of the respondents had knowledge on improved blackgram varieties and foliar application of MN mixture but after implementation of the programme it has been increased to 77.5 per cent and 82.5 per cent, respectively. This might be due to the high yield and marker price of improved blackgram variety VBN 6 and reduced flower

Table 3 : Distribution of respondents based on their knowledge level **(n = 40)**

Sr. No.	Category	Before OFT		After OFT	
		Number	Per cent	Number	Per cent
1.	Low	14	35	7	18
2.	Medium	16	40	20	50
3.	High	10	25	13	32
	Total	40	100	40	100

Table 4 : Knowledge level of the blackgram farmers in improved production technologies **(n=40)**

Sr. No.	Technologies	Before OFT programme		After OFT programme	
		Number	Percentage	Number	Percentage
1.	Application of Farm Yard Manure @12t/ha	32	80.0	35	87.5
2.	Improved blackgram varieties	11	27.5	31	77.5
3.	Optimum seed rate @20kg/ha	35	87.5	38	95.0
4.	Seed hardening treatments	5	12.5	28	70.0
5.	Seed treatment (*Trichodermaviride* @ 4g and Pseudomonas fluorescens @ 10 g/kg of seeds)	18	45.0	29	72.5
6.	Foliar application of MN mixture (TNAU Pulse wonder) @ 5 kg / ha	9	22.5	33	82.5
7.	Application of recommended fertilizer	22	55.0	36	90.0
8.	Weed management (Pre emergence application of Pendimethalin 3.3 litres/ha)	20	50.0	28	70.0
9.	Pest control (Setting up of yellow sticky traps @ 36 nos / ha to control sucking pest, Pheromone trap @ 12 nos / ha, spray of Chlorantroniliprole @ 0.3 ml /lit) to control white flies and pod borer)	19	47.5	30	75.0
10.	Disease control (Spot drenching with Carbendazim 1g / lit or application of *Pseudomonas luorescens* / *Trichodermaviride* 2.5 kg/ha with 50 kg FYM to control stem necrosis)	21	52.5	28	70.0

shedding by the foliar application of MN mixture that is TNAU Pulses wonder. More than 90 per cent of the respondents had knowledge on usage of optimum seed rate and the recommended fertilizer dosage. The appropriate reason for this high level of knowledge might be due to the on and off campus training programmes offered by KVK. Further, soil test was taken by KVK in OFT farmers' field and insisted them for judicious usage of fertilizer which led to reduction in fertilizer cost. With respect to the pest and disease management, 47.5 and 52.5 per cent of the responded had knowledge on the integrated pest and disease management in before implementation of the OFT and these has been increased to 75 and 70 per cent, respectively. The probable reason for this increased level of knowledge might be due to the result demonstration of the Integrated Pest and Disease Management practices conducted by KVK in OFT trial plots and which resulted in more yield and profit.

Conclusion :

It is concluded that seed hardening with Sodium molybdate @ 0.5g/lit performed better interms of yield (678 kg/ha), net return (Rs.23125/ha) and benefit cost ratio (1.81) compared to seed hardening with Zinc sulphate @ 0.1g/lit and control and which was 669 kg/ha, Rs.21913/ha, 1.77 and 514 kg/ha, Rs.12159 /ha, 1.45, respectively. Despite that, the minimum yield difference was observed between the seed hardening treatments that is both the seed hardening treatments were excelled over the untreated field. Hence, seed hardening with Sodium molybdate @ 0.5g/lit or Zinc sulphate @ 0.1g/lit for 3 hr found effective in increasing the yield in blackgram. The knowledge level of farmers on seed hardening treatments increased from 13 to 70 per cent which was made through OFT programme.

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