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Effect of natural pelleting using turmeric on seed germination of okra crop

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Abstract
Okra seeds have a relatively short viability period. Natural Seed pelleting of okra by using Turmeric offers several benefits like enhanced seed visibility, seed protection, seed treatment, germination and emergence. To determine the germination % of okra variety- Kashi Pragati, seeds were pelleted by turmeric and we used a complete randomized design (CRD) which was employed with six treatments with four replications, T_1 (10 gram turmeric powder), T_2- (25 gram turmeric powder), T_3- (50 gram turmeric powder), T_4- (75 gram turmeric powder), T_5- (100 gram turmeric powder) and T_6- (Control) were taken. We have recorded the Germination percentage, Dead seed percentage, Hard seed percentage, Root length, Shoot length and Seedling length. We observed that treatment T_2 (25 gm turmeric powder) shows the best results among all the treatments i.e. 97.0, 1.0, 2.0, 1.9, 3.3, and 5.6 respectively.

Keywords: Seed pelleting, seed treatment, germination, emergence, seed visibility, viability

Introduction
The Okra (*Abelmoschus esculentus*) also known as lady-finger or bhindi, belongs to the genus Abelmoschus and family Malvaceae. The seed shape of okra is generally described as oval or ellipsoid. Okra seeds are small, typically measuring around 5-7 millimeters in length. The seed coat is smooth and has a pale to dark brown color, depending on the variety. The size and shape of okra seeds may vary slightly among different cultivars. However, the overall oval or ellipsoid shape is characteristic of okra seeds. Okra fruit is called capsule. Okra is native to Africa and is an important crop in tropical countries. Okra is thought to have been introduced to India by the Bantu tribe, which moved there from Egypt around 2000 BC. They began growing the okra using the seeds they acquired as they travelled from the Eritrean plateau to the valleys of India and China. India is the world's largest producer of okra with over 60% of the global production. India produces approximately 6 million tons of okra per year. In India the production of okra is highest in Gujarat state comprising 1,019.42 tones and its share is 15.89%. Okra has production of 33.24 lakh metric tons from an area of 3.47 lakh hectares. The leaves of okra are heart-shaped and have lobes which are 3-5. The flowers of okra plant are yellow in color with a crimson-colored center. The fruit or pod, is hairy at the base. The flowers are yellow in color with a crims on center. Okra is primarily a warm-season crop that is found in tropical and subtropical regions. Predominantly, okra can be successfully grown at altitudes ranging from sea level up to around 1,500 meters (4,900 feet). The optimal altitude for okra cultivation is considered to be between 100 and 800 meters (330 to 2,600 feet) above sea level. These altitudes provide the warm temperatures and adequate sunlight that okra requires for proper growth and fruit development.
Seed pelleting is a process in which individual seeds are encapsulated with numerous materials to improve their handling, sowing, and overall performance. The coating materials can include substances such as polymers, fertilizers, beneficial microorganisms, pesticides, growth regulators, or other additives. The purpose of seed pelleting is to provide specific benefits to the seeds, such as protection against diseases and pests, enhanced germination and seedling emergence, improved seed handling and distribution, and targeted nutrient delivery. Generally, seed pelleting involves coating the seeds with a material to improve their handling, seedling emergence, and overall performance. Turmeric contains various compounds, including curcumin, which have antimicrobial and antioxidant properties. A germination rate of 75%, for example, means that 75 out of 100 seeds will likely germinate if sown in a favorable environment. Root-decaying diseases, which result in the death of the young seedlings, are the most serious disease problems in this crop. They are more prevalent when the crop is planted in cold, wet soil.

Rotting of small pods after the flowers drop is a fairly common problem with okra. Okra seeds have a relatively high moisture content, typically ranging from 10% to 15%. If the seeds are not properly dried before storage, they can be prone to mold growth and deterioration. Okra seeds have a relatively short viability period, generally ranging from 1 to 3 years, depending on storage conditions and seed quality. Over time, the germination rate of the seeds tends to decline, resulting in reduced seedling emergence. Okra seeds can be susceptible to damage by pests such as weevils, beetles, and moth larvae. Additionally, fungal diseases can infect the seeds during storage, causing decay and reducing seed quality. Seed pelleting of okra, as well as other crops, offers several benefits and is a common practice in modern agriculture some of them are improved seed handling, enhanced seed visibility, seed protection, seed treatment delivery, uniform germination and emergence, precision planting.

Materials and Methods

The experiments of the study were conducted in the Seed Research Laboratory of PLANTICA- Indian Academy of Rural Development, Dehradun, Uttarakhand. Seeds of Okra Variety-Kashi Pragati were obtained from G.B.P.U.A.T., Pantnagar, Uttarakhand. In this experiment we used a complete randomized design (CRD) method which was employed with six treatments with four replications.

Treatment No.	Treatment	Turmeric Powder (Gm)
1	T_1	10
2	T_2	25
3	T_3	50
4	T_4	75
5	T_5	100
6	T_6	Control (Without Turmeric)

Okra seeds were pelleted using organic turmeric locally produced in Uttarakhand hills and for adhesive a pinch of refined wheat flour for binding turmeric on seed coat was used. Each treatment had a specific organic material applied to the seeds. The pelleting process was carefully executed to ensure uniform coverage on the seed surface. In addition to this for the germination of okra seeds Petri plates were used in which 125mm Whatman No. 1 filter paper was used. In every replication 50 seeds were used which were constantly sprayed with distilled water when that sample was kept in germinator. The seeds from each treatment were sown in germination media. The trays were maintained under controlled conditions in the seed germinator and the temperature was set at 25 degree Celsius and humidity was kept above 90%. The observation for the germination of okra seeds was taken keenly and the length of seedlings were measured with the help of regular ruler. In addition to this, the germination percentage, hard seed, dead seeds, shoot length, root length, seedling length observation was taken. The germination percentage was calculated by the given formula:

$$\text{Germination percentage} = \frac{\text{No. of Germinated Seeds}}{\text{Total No. of Seeds}} \times 100$$

For calculating the Hard Seeds percentage, given formula was used:

$$\text{Hard Seeds percentage} = \frac{\text{No. of Hard Seeds}}{\text{Total No. of Seeds}} \times 100$$

For calculating the Dead Seeds percentage, given formula was used:

$$\text{Dead Seeds percentage} = \frac{\text{No. of Dead Seeds}}{\text{Total No. of Seeds}} \times 100$$

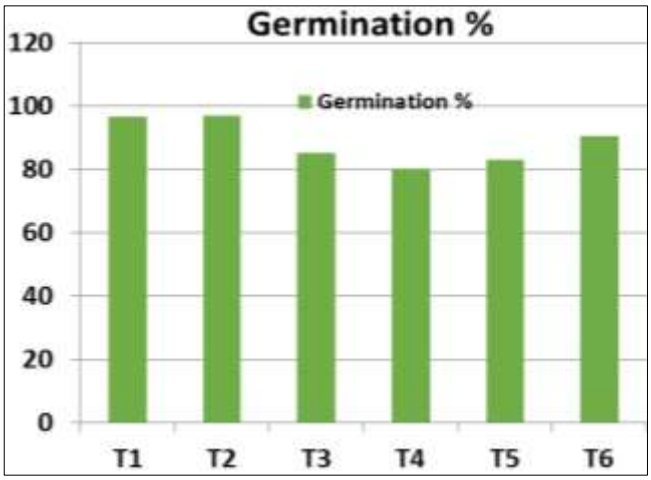
Besides this, root length, shoot length and seedling length was measured by regular ruler. For
ANOVA and other statistical data analysis MS Excel software was used.

Result and Discussion

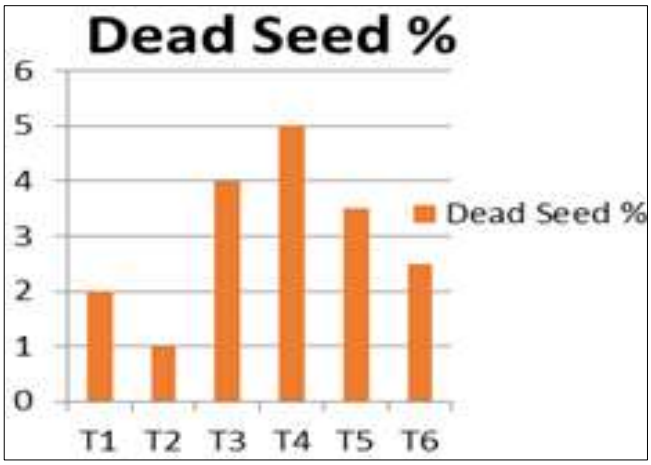
The results of following experiments are shown in the tables given below. The Germination percentage was recorded maximum in T_2 treatment (97.0±2.0) among all the other treatments. Treatment T1 (96.5±1.1) also revealed the good result on germination. Besides this, T_2 treatment and minimum germination percentage was recorded in treatment T_4 (80.0±1.1). Although, the similar study on okra seeds is not available however the effect of turmeric pelleting has been found on some other crops. Similar observation was also recorded on the study of Impact of Pelleting (Pre-storage) on the Germination Studies of two different Species of Ageing Bamboo Seeds as the seeds shown the maximum germination percentage after the treatment of bamboo seeds with turmeric powder. Statistically, it was observed that pelleting with turmeric powder resulted in maximum germination percentage of 36.4% and 24.9% over control at 12 and 18 months, respectively, which was zero in *Dendrocalamus hamiltonii*. (Singh *et al*, 2016) [11]. Another study also shows that, all concentrations of turmeric powder (10%) were effective in enhancing germination over the control. Such beneficial influence of eco-friendly and cheap botanicals in enhancing storability of seeds was reported by Nargis and Thiagarajan. Our results were in conformity with the reports of Tonapi [13] in cowpea seeds and Parashiva murthy [14] in soybean. In pelleted seeds among all the treatments, turmeric powder (10%) could be recommended for *Dendrocalamus hamiltonii* seeds as a pre storage invigoration treatment and in maintaining the best germination and VI over control at 5% level of significance. In addition, the minimum percentage of dead seeds in T_2 treatment (1.0±1.1) and maximum percentage of dead seeds was recorded in treatment T_4 (5.00±2.00). Moreover, the Hard seeds percentage was recorded lowest in T_2 treatment (1.5±1.1) and highest percentage was recorded in treatment T_5 (13.5±3.4).

Table 1: Effect of Turmeric Pelleting on the Germination, Dead Seed, and Hard Seed percentage

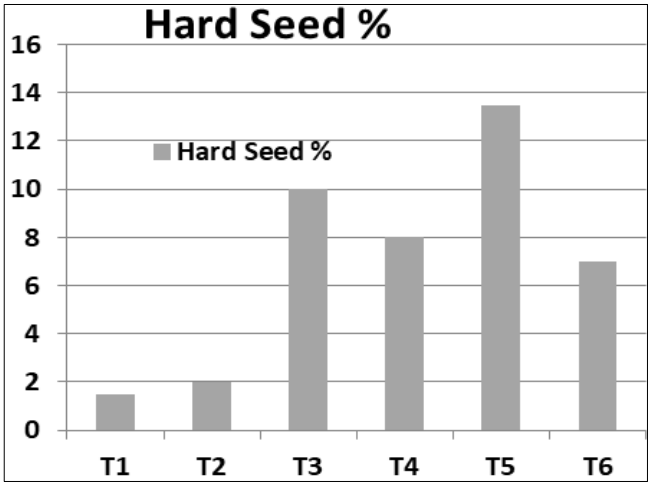
Treatment	Germination percent	Dead Seed percent	Hard Seed percent
T1	96.5±1.1	2.0±0.0	1.5±1.1
T2	97.0±2.0	1.0±1.1	2.0±1.1
T3	85.0±2.3	4.0±3.0	10.0±3.0
T4	80.0±1.1	5.0±2.0	8.0±2.0
T5	83.0±2.3	3.5±1.1	13.5±3.4
T6	90.5±1.1	2.5±1.1	7.0±2.0
SD (±)	1.6	1.42	2.1
CD(P=0.5)	3.1	NS	3.1



Graph 1: Effect of Turmeric Pelleting on the Germination percent



Graph 2: Effect of Turmeric Pelleting on the Dead Seed percent

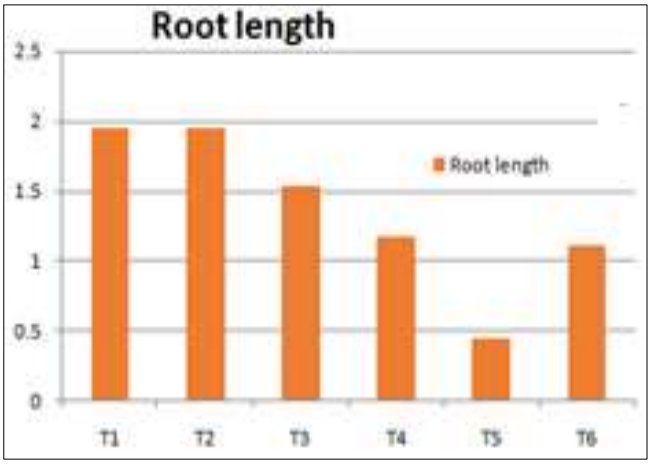


Graph 3: Effect of Turmeric Pelleting on the Hard Seed percentage

The maximum root length was recorded in treatment T_2 (1.95±0.34) shows also the similar result, the minimum root length was recorded in treatment T_5 (0.45±0.60). Also, the length of shoot of treatment T_1 (3.6±0.4) was recorded maximum shoot length and minimum shoot length was recorded in treatment T_5 (1.7±0.0). Finally, the maximum seedling length was recorded in treatment T_2 (5.6±0.6) and minimum seedling length was recorded in treatment T_5 (1.74±2.35). Hence, Treatment T_2 showed the best results among all the treatments.

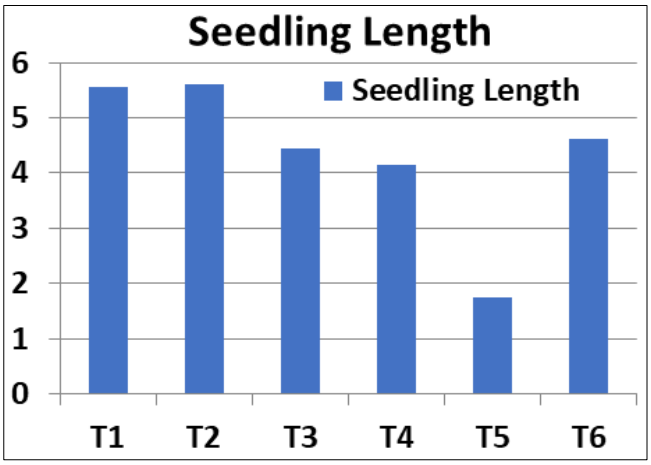
Table 2: Effect of turmeric pelleting on Root length, Shoot length and Seedling length

Treatment	Root length	Shoot length	Seedling length
T_1	1.9±0.6	3.6±0.4	5.5±1.0
T_2	1.9±0.3	3.3±0.5	5.6±0.6
T_3	1.5±0.5	3.1±0.2	4.4±1.0
T_4	1.1±0.3	3.3±0.2	4.1±1.3
T_5	0.4±0.6	1.7±0.0	1.7±2.3
T_6	1.1±0.1	3.6±0.4	4.6±0.7
SD (±)	0.43	0.30	1.18
CD (P=0.5)	3.1	3.1	



Graph 4: Effect of Turmeric Pelleting on Root length

Graph 5: Effect of Turmeric Pelleting on Shoot length



Graph 6: Effect of Turmeric Pelleting on Seedling length

Conclusion

In Conclusion, this experiment investigated the "Effect of Natural pelleting using Turmeric on Seed germination of Okra crop" The study aimed to determine whether the application of turmeric seed pelleting could enhance the germination rate and overall seed performance of okra. For this, several experiment series, experimental findings were obtained. The results shows that the Germination percentage of okra found maximum in treatment T_2 i.e. 97%. While, the Dead seed percentage, found minimum in treatment T_2 than the others i.e. 1%. Hard seed percentage found to be minimum in Treatment T_1 i.e. 1.5%. When we see the effect of turmeric pelleting on Root length, Shoot length and Seedling length, then we found that the maximum root length was recorded in treatment T_1 & treatment T_2 shows also similar to T_1 i.e. 1.9 cm, when we observe the shoot length then, maximum was recorded in treatment T_1 & T_6 shows also the similar results i.e. 3.6 cm, while maximum seedling length was recorded in treatment T_2 i.e. 5.6 cm. From the above results we observed or concluded that treatment T_2 (25 gm turmeric powder) shows the best results among all other treatments.

Author's contribution

Conceptualization of research (N.Q)
Designing of the experiments (A.D, A.B)
Contribution of experimental materials (A.D)
Execution of field/lab experiments and data collection (N.Q)
Analysis of data and interpretation (N.Q)
Preparation of the manuscript (N.Q, A.D)

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