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Research Article

Effect of seed treatments on seed germination and seedling parameters in the F_2 generation of mundu chilli (*Capsicum annum* L.)

M. Kabilan*
Horticultural College and Research Institute, Tamil Nadu Agricultural University, Periyakulam (Tamil Nadu), India
R. Balakumbahan
Horticulture and Forest Research Station, Tamil Nadu Agricultural University, Thadiyankudisai, (Tamil Nadu), India
K. Nageswari
Horticultural College and Research Institute, Tamil Nadu Agricultural University, Periyakulam, (Tamil Nadu), India
S. Santha
Agricultural College and Research Institute, Tamil Nadu Agricultural University, Kudumiyanmalai (Tamil Nadu), India

*Corresponding author. Email: kabimathi21@gmail.com

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Abstract
Germination in chilli seeds is poor and the duration taken for the germination is long. In order to overcome their problems in germination, the seeds were to be subjected to seed treatments, So that the germination would be effective. The experiment was conducted at the Department of Vegetable Science HC & RI, Tami Nadu Agricultural University (TNAU), Periyakulam to study the effect of seed treatment views on the seedling character of mundu chilli. The experiment was laid in FCRD design with three replications. In this study, four F_2 crosses *viz.,* PKM CA 20 X PKM CA 08 (C_1), PKM CA 32 X PKM CA 33 (C_2), PKM CA 32 X PKM CA 20 (C_3), PKM CA 38 X PKM CA 33 (C_4) and seven treatments namely, Control (T_0), Seed treatment with KNO_3 0.5% (T_1), Seed treatment GA_3 50 ppm (T_2), Seed treatment with NAA 100 ppm (T_3), Hot water seed treatment at 60° C for 15 minutes (T_4), Seed treatment with cow urine (T_5), Seed treatment with *Trichoderma viride* (T_6). Among all F_2 crosses, PKM CA 38 X PKM CA 33 (C_4) was most responsive to seed treatments in terms of the percent of seed germination and vigor index, followed by progeny PKM CA 32 X PKM CA 33 (C_2) for root length and PKM CA 32 X PKM CA 20 (C_3) for shoot length. The statistical analysis of the data showed the superiority of all the seed treatments over the control. The GA treatment resulted in the maximum percentage of seed germination, root length, shoot length and vigor index followed by KNO_3. GA_3 breaks the dormancy in the seeds and induces seed germination rapidly. Thus GA3 finds its way as the seed treatment agent in chilli.

Keywords: Germination, Mundu chilli, Seed treatment, Seed vigor index.

INTRODUCTION

Chilli (*Capsicum annuum* L.) belongs to the Solanaceae family and is well known for its spicy and strong food colouring potential. It has an area of 10,61,000 hectares in India, with an annual production of 57.93 lakh tones, yielding 2.59 MT per hectare per annum. In Tamilnadu, it covers an area of 64,25 hectares with 27.46 lakh tones of production (National Horticulture Board, 2020). India is the largest producer and exporting chilli production of elite seedlings is essential. Delayed seedling emergence and irregular seedling growth result in low seedling vigor and nonuniform seedlings for production (Demir and Okcu, 2004). Furthermore, seedlings of capsicum are susceptible to collar rot disease, which is due to *Rhizoctionia solani* and necessitates seed priming. For high-quality planting material production, especially among transplanted vegetables, rapid and uniform seedling emergence is necessary. Presowing seed treatments can be beneficial for achieving faster, uniform germination and emergence for enhanced growth and producing healthy planting materials against pathogens (Demir and Okeu, 2004). The present study aimed to find the effect of seed treatments on seed germination and seedling parameters in the F_2 generation of mundu chilli (*Capsicum annum* L.).

MATERIALS AND METHODS

Four Mundu chilli (*C. annuum* L.) F_2 generations *viz.,* PKM CA 20 X PKM CA 08 (C_1), PKM CA 32 X PKM CA 33 (C_2), PKM CA 32 X PKM CA 20 (C_3), and PKM CA 38 X PKM CA 33 (C_4), were obtained from genetically pure fresh seeds from the Department of Vegetable Science, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Periyakulam, Tamil Nadu, and used for the study. Seven treatments were used: T_0 - Control, T_1 - Seed treatment with KNO_3 (0.5% solution), T_2 - Seed treatment GA_3 (50 ppm solution), T_3 - Seed treatment with NAA (100 ppm solution), T_4 - Hot water seed treatment at 60° C for 15 minutes, T_5 - Seed treatment with cow urine (1: 1 w/v), T_6 - Seed treatment with *Trichoderma viride*. Soaking of seeds in an equal volume of different concentrated solutions. The treated seeds were sown in Protray filled with low Electrical conductivity, neutral p^H coir pith media and kept under a mist chamber. Data on percent seed germination, root length, shoot length and seed vigor index were recorded. The experiment was carried out using a factorial completely randomized design (FCRD). Each treatment was replicated three times. The obtained data on various factors were statistically evaluated (Panse *et al*., 1954).

RESULTS AND DISCUSSION

Effect of seed treatment on seed germination in F_2 crosses of mundu chilli

The factors seed treatment (T) and F_2 generation (C) differed significantly in seed germination, but there was no significant difference in the interaction between seed treatment (T) and F_2 generation (C). The mean value of treatment on seed germination be mentioned (Table 1). In the experiment, the seeds treated with 50 ppm GA_3 (T_2) had a higher germination percentage of 69% followed by 0.5% KNO_3 treatment (68.00 %), and the lowest germination was observed in the control treatment (T_1), with a germination percentage of 57.00 %. Comparing the different F_2 crosses, there was a significant difference among the F_2 crosses with respect to seed treatment. Higher germination was recorded in the crosses C_4 (63.85 %), which was on par with C_2 (63.32 %) and C_1 (63.28 %). Among the interaction effects of F_2 crosses and seed treatments, there was no significant difference among the crosses with respect to seed treatment. The interaction C_1T_2 (69.00 %) registered the highest germination, followed by C_1T_1 and C_2T_2 and the lowest germination was 61.00 % in C_1T_4. Better seed germination by GA_3 treatment resulted in maximum germination because GA_3 induced enzymes that digest the endosperm quickly and efficiently, reducing the obstacles through which sustainable embryo growth was facilitated, which occurred quickly during the early stages of germination. Similarly, a high germination percentage was reported by Reddy and khan (2001), Ruminska *et al.* (1978) in cucurbits, Natesh *et al.* (2005), Andreoli and Khan (1999) in chilli, Yogananda *et al.* (2004) in hot pepper Vaktabhai *et al.* (2017), and Javed and afzal (2020) in tomato.

Effect of seed treatment on seedling parameters in F_2 crosses of mundu chilli

The root length, shoot length and seedling vigor index of F_2 generations of mundu chilli were significantly influenced by seed treatment and the F_2 crosses also differed among them. The presowing treatment of seeds

Table 1. Effect of seed treatment on seed germination (%) in the F_2 generation of mundu chilli

Treatments	**Seed germination (%)**				
	C_1	**C_2**	**C_3**	**C_4**	**Mean**
T_0	57.00	59.00	54.00	58.00	57.00
T_1	68.00	67.00	64.00	67.00	66.50
T_2	69.00	68.00	66.00	68.00	67.75
T_3	62.00	63.00	62.00	65.00	63.00
T_4	61.00	62.00	60.00	64.00	61.75
T_5	63.00	64.00	63.00	63.00	63.25
T_6	63.00	60.00	61.00	62.00	61.50
Mean	63.28	63.32	61.43	63.85	440.75
Source	Sed		CD 5%		
F_2 generation	0.49		0.99		
Treatment	0.65		1.31		
Interaction	1.31		2.62		

T_0 - Control, T_1 - Seed treatment with KNO_3 (0.5% solution), T_2 - Seed treatment GA_3 (50 ppm solution), T_3 - Seed treatment with NAA (100 ppm solution), T_4 - Hot water seed treatment at 60° C for 15 minutes, T_5 - Seed treatment with cow urine (1: 1 w/v), T_6 - Seed treatment with *Trichoderma viride;* C_1 - PKM CA 20 X PKM CA 08, C_2 - PKM CA 32 X PKM CA 33, C_3 - PKM CA 32 X PKM CA 20, and C_4 - PKM CA 38 X PKM CA 33

Table 2. Effect of seed treatment on seedling root length (cm) in the F_2 generation of mundu chilli

Treatments	Seedling root length (cm)				
	C_1	C_2	C_3	C_4	Mean
T_0	4.20	4.80	4.60	4.40	4.50
T_1	6.20	6.50	6.40	6.10	6.30
T_2	6.80	6.90	6.80	6.70	6.80
T_3	5.60	5.80	5.60	5.40	5.60
T_4	4.30	4.90	4.80	4.60	4.65
T_5	5.30	5.90	5.40	5.60	5.55
T_6	5.60	5.80	5.40	5.70	5.63
Mean	5.43	5.80	5.57	5.50	39.03
Source	Sed		CD 5%		
F_2 generation	0.042		0.084		
Treatment	0.055		0.112		
Interaction	0.111		0.224		

T_0 - Control, T_1 - Seed treatment with KNO_3 (0.5% solution), T_2 - Seed treatment GA_3 (50 ppm solution), T_3 - Seed treatment with NAA (100 ppm solution), T_4 - Hot water seed treatment at 60° C for 15 minutes, T_5 - Seed treatment with cow urine (1: 1 w/v), T_6 - Seed treatment with *Trichoderma viride;* C_1 - PKM CA 20 X PKM CA 08, C_2 - PKM CA 32 X PKM CA 33, C_3 - PKM CA 32 X PKM CA 20, and C_4 - PKM CA 38 X PKM CA 33

Table 3. Effect of seed treatment on seedling shoot length (cm) in the F_2 generation of mundu chilli

Treatments	Seedling shoot length (cm)				
	C_1	C_2	C_3	C_4	Mean
T_0	14.30	13.80	14.70	14.20	14.25
T_1	15.80	15.40	15.60	15.90	15.68
T_2	16.90	17.10	16.80	16.50	16.83
T_3	15.30	15.10	15.20	15.40	15.25
T_4	14.50	14.20	14.40	14.10	14.30
T_5	15.60	15.50	15.60	15.60	15.58
T_6	15.40	15.20	15.40	15.20	15.30
Mean	15.40	15.19	15.39	15.27	107.18
Source	**Sed**		**CD 5%**		
F_2 generation	0.112		0.224		
Treatment	0.148		0.297		
Interaction	0.297		0.595		

T_0 - Control, T_1 - Seed treatment with KNO_3 (0.5% solution), T_2 - Seed treatment GA_3 (50 ppm solution), T_3 - Seed treatment with NAA (100 ppm solution), T_4 - Hot water seed treatment at 60° C for 15 minutes, T_5 - Seed treatment with cow urine (1: 1 w/v), T_6 - Seed treatment with *Trichoderma viride;* C_1 - PKM CA 20 X PKM CA 08, C_2 - PKM CA 32 X PKM CA 33, C_3 - PKM CA 32 X PKM CA 20, and C_4 - PKM CA 38 X PKM CA 33

with 50 ppm GA_3 (T_2) had a better root length of 6.80 cm, followed by 0.5% KNO3 (6.30) and the lowest root length was observed in seeds treated with the hot water treatment with a root length of 4.65 cm. Comparing the different F_2 generations, a higher root length (5.80) was recorded in cross C_2, which was on par with C_3 (5.57). Among the interaction effects of crosses and seed treatments, C_2T_2 registered the highest root length (6.90), which was on par with C_3T_2 (6.80). The lowest root length (4.20 cm) was recorded in C_1T_0 (Table 2). The increased root length may be due to GA_3 increasing the activity of many enzymes involved in lipid and sucrose conversion during germination, such as isocitrate lyase, malate synthase, and malate dehydrogenase. Similar findings have been reported by Kumar (2005) and Bassi *et al.* (2007) in brinjal, Peyvast *et al.* (2009) in cucumber, Farooq *et al.* (2007) in muskmelon Jyothi *et al.* (2016) in tomato, and Oliveira *et al.* (2019) in melons.

Both factors and interactions differed significantly in shoot length. It is obvious from the data provided in (Table 3) that the seeds treated with 50 ppm GA_3 (T_2) had lengthy shoots of 16.83 cm, followed by 0.5% KNO3 (15.68 cm), and the lowest shoot length was

Table 4. Effect of seed treatment on the seed vigor index in F_2 generation of mundu chilli

Treatments	Seed vigor index				
	C_1	C_2	C_3	C_4	Mean
T_0	1068.75	1106.25	1012.50	1087.50	1068.75
T_1	1494.64	1472.66	1406.72	1472.66	1461.67
T_2	1630.47	1606.84	1559.58	1606.85	1600.93
T_3	1292.70	1313.55	1292.70	1355.25	1313.55
T_4	1155.95	1174.90	1137.00	1212.80	1170.16
T_5	1331.19	1352.32	1331.19	1331.19	1336.47
T_6	212.31	1255.80	1276.73	1297.66	1287.20
Mean	1327.47	1326.05	1288.06	1337.70	9238.73
Source	Sed		CD 5%		
F_2 generation	11.789		23.61		
Treatment	15.595		31.24		
Interaction	31.191		62.48		

T_0 - Control, T_1 - Seed treatment with KNO_3 (0.5% solution), T_2 - Seed treatment GA_3 (50 ppm solution), T_3 - Seed treatment with NAA (100 ppm solution), T_4 - Hot water seed treatment at 60° C for 15 minutes, T_5 - Seed treatment with cow urine (1: 1 w/v), T_6 - Seed treatment with *Trichoderma viride;* C_1 - PKM CA 20 X PKM CA 08, C_2 - PKM CA 32 X PKM CA 33, C_3 - PKM CA 32 X PKM CA 20, and C_4 - PKM CA 38 X PKM CA 33

observed in seeds treated with hot water, with a shoot length of 14.30 cm. Comparing the different F_2 crosses, a higher shoot length (15.40 cm) was recorded in cross C_4, which was on par with C_3 (15.39 cm). Among the interaction effects of F_2 crosses and seed treatments, C_2T_2 registered the highest shoot length (17.10 cm), which was on par with C_1T_2 (16.90 cm). An inferior shoot length of 13.80 cm was observed in C_2T_0. GA_3 and KNO_3 might have enhanced enzymatic activity during germination; hence, increased shoot length can be linked to the rise in seedling length, which was corroborated with the findings of Bassi *et al.* (2007), and Peyvast *et al.* (2009) in cucumber and Singh *et al.* (1999) in muskmelon, Sharma *et al.* (2014) in bhendi, and Javed and Afzal (2020) in tomato.

Both factors and interactions differed significantly in the seed vigor index. As per the data recorded (Table 4), the highest seed vigor index of 1600.93 was exhibited by GA_3 50 ppm (T_2), followed by KNO_3 0.5% (1461.67), and the lowest seed vigor index was observed in seeds treated with hot water over the control, with a seed vigor index of 1170.16. Comparing the different F_2 crosses, a higher seed vigor index (1337.70) was recorded in cross C_4, which was on par with C_1 (1327.47). Among the interaction effects of F_2 crosses and seed treatments, C_1T_2 registered the highest seed vigor index (1630.47), which was on par with C_4T_2 (1606.85). The lowest seed vigor index (1137.00) was recorded in C_3T_4. The greatest vigor index was found in the GA_3 and KNO_3 treatments. This might be due to increased amylase activity caused by growth regulators or salt solutions breaking down starch contained in seeds. This finding was partially supported for seed vigor index by Islam *et al.* (2012) in *Momordica charantia*, Singh and Lal (2005) in tomato, Kumar (2005) and Valeria *et al.* (2012) in brinjal, Yogananda *et al.* (2004) in sweet pepper, and Oliveira *et al.* (2019) in melons.

Most of the research is focused on seed germination of other vegetable crops, not on chilli. The present investigation in chilli focused in seed germination using different various seed treatment chemicals. The seed treatment with GA_3 resulted in the maximum percentage of seed germination, root length, shoot length and vigor index followed by KNO_3. GA_3 stimulates the cells of the germinating seeds to produce mRNA molecules that code for the hydrolytic enzyme. Thus, the GA_3 break the dormancy in seeds and enhance seed germination. GA_3 treated seeds get germination within a short period of time.

Conclusion

This study revealed that the seed treatment with GA_3 can aid in better germination, producing healthy, disease-free, and morphologically strong seedlings and promoting the development of vigorous mundu chilli (*C. annuum* L.). The seedlings GA_3 treatment, followed by KNO_3 treatment, was proven to be the best seed treating chemical for producing healthy and uniformly sized seedlings.

Conflict of interest

The authors declare that they have no conflict of interest.

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