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Original Research Article

Influence of Seed Coat Treatments on Seedling Emergence of Carrot (*Daucus carota L.*)

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Keywords

Emergence; vigour; Plant growth; seed germination; Seed Pelleting

A B S T R A C T

The influence of pre-sowing treatments using biogas slurry and Thirame on germination, seedling emergence and plant population of carrot was examined and compared with un-coated carrot seed in laboratory and in field. The experiment was conducted in Division of Agricultural Engineering, IARI New Delhi. The both treatments namely biogas slurry coating (T_2) and Thirame coating (T_3) improved the germination per cent and seedling emergence of carrot significantly. In the laboratory experiment, the highest germination percentage was 80.4% for treatment T_2 and followed by 76% for treatment T_3. The lowest germination of 68.5% was recorded for treatment T_1. Highest emergence rate of 11.1% was recorded for treatment T_3 followed by 9.88% in treatment T_2. Emergence rate was lowest for treatment T_1. In field, highest germination was recorded for treatment T_2 (89.5%) followed by the treatment T_3 (79.5%). The lowest germination (73%) was recorded for treatment T_1. Emergence rate of 13.6% was recorded for treatment T_2 followed by 11.2% in treatment T_3 and 7.9% in treatment T_1. The present study suggests that, pre-sowing seed treatments could improve rapid and uniform seeding emergence of carrot seed, plant growth, increase the yield, and ultimately profits in crops.

Introduction

Over the past few years higher seedling establishment through seed treatments, coating, pelleting, priming has led to great improvements in a grower's potentiality to achieve his goal in both the field and laboratory. Numerous vegetable crop species have been treated with chemicals, fungicides, etc., successfully.

In order to maintain a favourable condition for seed in seedbed, one has to maintain seed quality and longevity in the treated seed. Rapid and uniform field emergences are two essential prerequisites to increase yield, quality, and ultimately profits in crops. Uniformity and percentage of seedling emergence of direct-seeded crops

have a major impact on final yield and quality. Slow emergence results in smaller plants and seedlings, which are more vulnerable to soil-borne diseases. Prolonged emergence periods predispose the planting bed to deterioration and increased soil compaction, particularly under adverse environmental conditions. Poor germination is a common phenomenon at sub-optimal temperatures, which is a great concern of growers that grow seedlings in late winter and early spring in the Mediterranean region. Optimum seed germination and seedling emergence occur at relatively high temperatures (20–30°C) for several species. e.g. tomato, bean, watermelon, cucumber (Tuna Do and Ahmet Zeybek 2009). Nowadays, various techniques have been developed for treating seeds prior to sow in the field to improve seed quality and vigour. Traditionally, the growers use the red soil for seed treatment for crops like red gram, cowpea, chickpea etc., and Solid matrix priming (SMP) is a term used for a pre-sowing seed treatment in which a solid-matrix instead of an osmotic solution is used to enhance germination(Gault and Brockwell 2008). Seed maturation stage can also be an influential factor in germination performance at low temperatures and response to priming treatment (Powel and Mathews 1988). Several studies on seed germination and seed emergence revealed the beneficial effects of seed treatment by several ways (pelleting, soaking, coating, scarification, priming) (Vanangamudi *et al*., 2003).

High temperatures during sowing may delay or inhibit carrot seed germination. Consequently, seed priming may be used as an important tool to improve seed performance and stand establishment in the field (e.g. carrot), especially during the summer (Bahadur singh *et al.,2006*). The objectives of this paper were: (i) to develop effective pre-sowing treatments to stimulate seed germination and seedling vigour, and (ii) to determine the carrot seedling emergence for different seed treatments under laboratory and field conditions.

Materials and Methods

Seed Source

Crop variety 'Nantes' was used in the experiments and planting. It is a European cultivar which can be grown in the plains of India for root production. The roots are half long, slim well-shaped, cylindrical with stumped end, forming a small thin tail, deep orange red cortex and core. This cultivar is suitable for cultivation in cooler month.
Seed coating experiments were conducted at the Indian Agricultural Research Institute, New Delhi in 2010. The seeds of variety *Nantes* were used throughout the experiment. The seeds were cleaned, graded using laboratory cleaner-cum-grader and sieved for uniform seeds. Biogas slurry and Thirame fungicide were used as coating materials. Three different concentrations (Slurry: Seed. 1: 1, 1:2 and 1:4) prepared are used for coating.

Seed Coating Set-Up

The horizontal axis, manually operated seed coating equipment (Fig.1a) was used for coating the seeds. A simple seed coating machine was developed consisting of Hopper, Screw mixer and conveyor; Sliding gate for feed control, Handle and Housing. The operation of machine is simple. The prepared concentration of seed and bio-gas slurry (w/w) mixer is filled to the hopper. Hopper gate is slided out to allow the material to flow onto screw, which is rotated by handle. Once handle rotates the screw auger, seed mixer in contact with screw gets coated to the prepared concentrations. The

coated seed discharges through the rectangular outlet below.

Germination and Emergence
Germination Percentage

Four hundred seeds of each treatment were distributed over two layers of germination paper previously moistened with water equivalent to three times the dry weight of the paper, in germination boxes, and incubated at 20ºC. The first germination was counted on 7th day and last counting was on 14th day in laboratory trials.

Seedling emergence

Sowing was done on December 21st 2010 using raised bed mechanical carrot planter. As per the carrot theoretical spacing 5cm with row spacing of 7.5cm, 20 seeds were sown in meter length of bed (Shiddanagouda *et.al*., 2012). Soil moisture was kept sufficiently wet for germination. Carrot seedling emergence rate was counted for several days at each plot during the mean emergence date (MED) in 1 m length of row, with 3 replications. The emergence rate index (ERI) was calculated directly from emergence counts as follows:

Results and Discussion

The effectiveness of coating with single seed was observed to be the maximum (92%), when treatment S_2 was used with 15 min time of coating (Table.1). In case of treatment S_1 with 15 min time of coating, effectiveness was minimum (77%). The lumps of carrot seeds were formed during the hand mixing, which was avoided in the mechanical coating by horizontal coating equipment. Regarding the performance of equipment and proportions, material of 1:1 and 1:4 produced more lumps of carrot seeds. Material of concentration 1:2 gave better results in terms of single seed after coating.

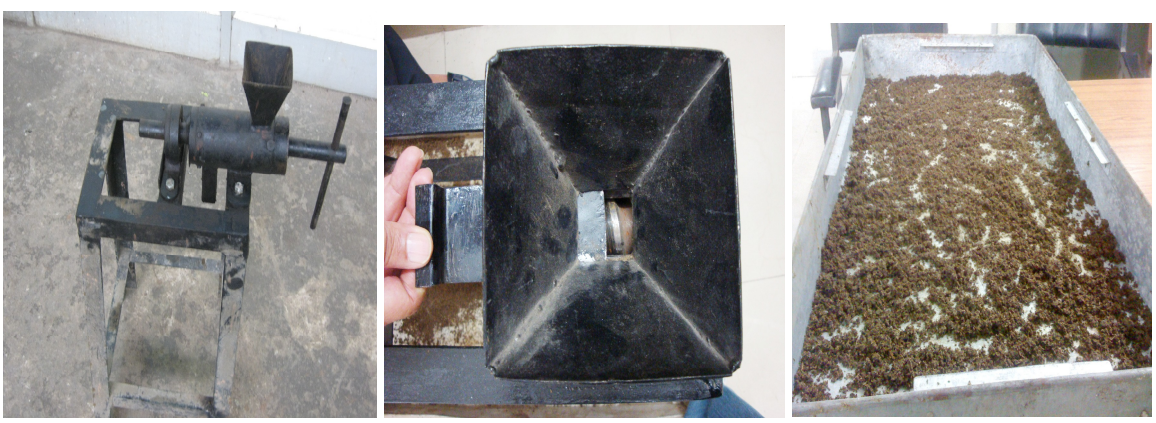


Fig.1 (a) Seed coating machine, (b) Hopper and (c) Slurry coated seeds

$$\text{MED} = \frac{N_1 D_1 + N_2 D_2 + \cdots + N_n D_n}{N_1 + N_2 + \ldots + N_n}$$

$$\text{ERI} = \frac{\text{Number of emerged plants/sq.m}}{\text{MED}}$$

where N_1, N_2, ..., Nn is the increase in the number of newly emerged plant stems compared with the previous count and D_1, D_2, ..., Dn is the number of days after planting.

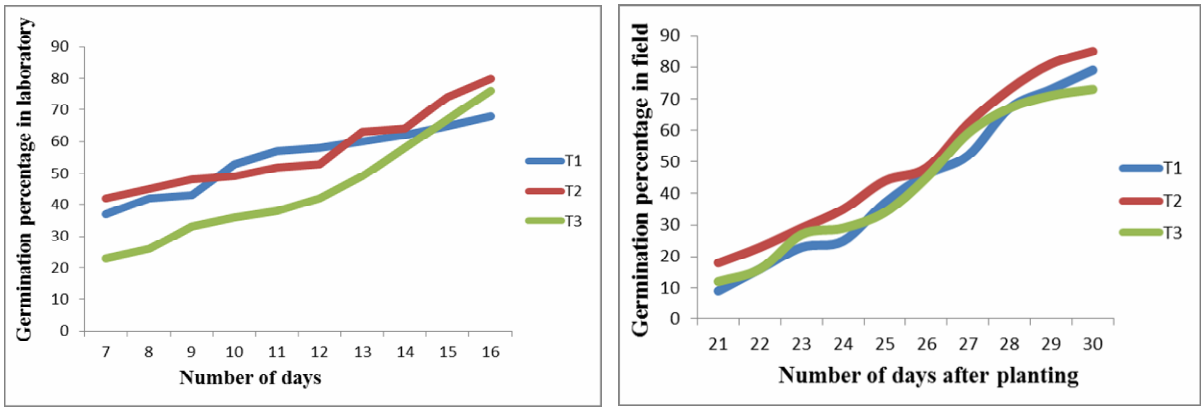
Table.1 Effectiveness of carrot seed coating under different treatments of concentrations

Treatments of material concentration	Time of coating	Effectiveness of coating			
		With one seed	With two seeds	With more than 2 seeds	Without seeds
S_1-slurry: Seed, 1:1	5	79	6	8	7
	10	83	5	7	5
	15	77	8	8	7
S_2-Slurry:Seed, 1:2	5	94	3	2	1
	10	89	5	3	3
	15	91	6	2	1
S_3- Slurry: Seed, 1:4	5	77	7	12	4
	10	83	6	5	6
	15	84	4	7	5

Table.2 Germination percentage of carrot seed under different seed treatments

Replications	Germination percentage		
	Seed Treatments		
	T_1	T_2	T_3
R_1	71	94	82
R_2	77	85	85
R_3	74	87	80
R_4	69	85	77
R_5	73	93	79
R_6	66	88	75
R_7	75	91	81
Average	**72.16**	**89.57**	**79.85**

Fig.2 Percentage germination in laboratory and in field under different seed treatments



In laboratory experiment, number of plants emerged were counted from 7th day to 16th day during germination test in laboratory. The germination commenced exactly on 7th day. The average germination percentage on different days after planting is shown in Fig.2. On 16th day highest germination percentage was recorded for treatment T_2 (80.4%) followed by T_3 (76%). Lowest germination was recorded for T_1 (68.5 per cent). In field germination was commenced on 21st day after planting, it was due to the late sowing. On 30th day after planting, highest germination was recorded for treatment T_2 (89.5%) followed by treatment T_1 (79.5%). The lowest germination (73%) was recorded for treatment T_3.

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