

Original Research Article

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Germination Behaviour of Cuscuta Seeds in Different Environments and Its Interaction Effect on Major Host Niger (*Guizotia abyssinica* (L. f.) Cass.)

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ABSTRACT

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The present experiment was carried out at AICRP on Niger scheme, Regional Research and Technology Transfer Station (OUAT), Semiliguda of Koraput district under Eastern Ghat High Land zone of Odisha during *kharif* season of 2017 to study the germination behaviour and interaction effect of Niger and Cuscuta seeds on each other. Niger is the major host for Cuscuta survive and further growth. After germination it continuously attached with the Niger plant and takes nutrition from the host and also damages the plant. Experiment was conducted to see the germination behavior of both host and parasite within specific condition. Result revealed that Niger seeds can be germinated if sown with soil or without soil or with Cuscuta seeds. Cuscuta seeds can also be germinated if sown with soil or without soil or with Niger seeds. Some seed interactions were observed during Niger sowing with Cuscuta seeds that it reduces the germination of Niger seeds. Niger seeds do not affect the germination of Cuscuta seeds. Study was also concluded that Niger is the prominent host for Cuscuta but it is not required during initial phase for germination and also not affects the germination of Cuscuta seeds. So effective preventive, agronomic measures can be taken to reduce Cuscuta infestation in the field during initial phase.

Introduction

Niger (*Guizotia abyssinica* (L. f.) Cass.) is an minor oilseed crop and cultivated in Indian subcontinent and East African Countries (Getinet and Sharma, 1996). It is grown in India in an area about 2.99 lakh ha with a production of 0.98 lakh tones and a productivity of 327 kg/ha . In the state of

Odisha, it covers an area of 0.65 lakh ha with a production of 0.23 lakh tonnes and productivity of 360 kg/ha.(Oilseeds Statistics - A Compendium 2015). The seeds contain about 40% edible oil with fatty acid composition of 75-80% linoleic acid, 7-8% palmitic and steric acids, and 5- 8% oleic acid (Dutta *et al.* 1994). The meal remaining after

the oil extraction is free from any toxic substances but contains more crude fiber than most oilseed meal Dutta et al. (1994) reported that the Ethiopian niger seed oil contains more than 70% linoleic acid, whereas, (Dagne and Johnsson ;1997) reported 66-69% linoleic acid. In all the works so far done on the fatty acid composition of Niger, linoleic acid is unequivocally the dominant fatty acid present in niger seed oil followed by palmitic, oleic and stearic acids (Dutta *et al* ;1994 and Dagne and Johnsson; 1997). The percentage of oleic acid in the Ethiopian Niger seed oil was reported to be in the range of 6-11% (Dutta *et al.*, 1994), 5.4-7.5% .(Dagne and Jonsson ;1997). It is indicated that the oil content and the fatty acid profile may vary depending on the origin of the material and the maturity level of the seeds. The quality of oil and its suitability for a particular purpose is it for industrial use or for human consumption depends on the proportion of the different fatty acids it contains. There are opportunities which favour cultivation of oilseeds in general in the country which ranges from import substitution of edible oils to export of high value seed and oil. Niger seed is generally used for cooking purpose in tribal areas of many states and major part is exported to the foreign countries for bird feed.

Like other crops Niger also affected by many weeds and *Cuscuta* is one of them which cause severe yield reduction. Niger is the major host for *Cuscuta* and it takes nutrition through haustoria from the stem and some time plant can also die. Many other crop plants like tomato, carrot also behave like host for *Cuscuta* and help to complete the life cycle of *Cuscuta*. Seeds germinate near the soil surface and send up thread-like twining stems varying in color from pale green to yellow or orange and without any cotyledons. The slender, leafless, thread-like stem rotates slowly until it touches the stem or leaf of another plant and begins to wind around it. On a host plant, the *Cuscuta* stem will

immediately form small appendages called haustoria, which penetrate the stems or leaves so that it can extract its necessary growth requirements. Soon after attaching to a host plant, the lower end of the *Cuscuta* breaks its connection with the ground, while the upper part of the stem grows rapidly but if the *Cuscuta* seedlings are unable to contact a susceptible host plant soon after germination, they will not survive for a long time. (Jamshid Ashigh *et al*,2010).

Cuscuta flowers are numerous, tiny, whitish to pinkish, and form in small clusters along the stems, generally from May to October, depending on the species and location The seeds have rough coats and vary in size, depending on the species, and may be able to survive over 20 years in the soil *Cuscuta* infestations reduce crop yield and increase harvesting costs. The damage of dodder to the host plant varies from moderate to severe depending on the growth of the host plant and on the number of haustoria attachments to the host plant. (Jamshid Ashigh *et al.*, 2010).

Niger is the major host for *Cuscuta* but *Cuscuta* can also germinate without Niger or even without soil condition. Niger seeds can also be remained in dormant condition in soil and may be germinated when favourable conditions available. After germination it is very difficult to control the *Cuscuta* so effective measures should also be taken during field preparation. (Allred *et al.*, 1964) *Cuscuta* management is only achieved using combined preventive, cultural, mechanical and chemical methods that aim at control of existing populations prior to seed production and control of subsequent seedlings.

Materials and Methods

The experiment was conducted at AICRP on Niger scheme, Regional Research and Technology Transfer Station, Semiliguda, Odisha during *Kharif* -2017. Niger and

Cuscuta seeds were sown in six different ways in the plastic bowls and made the six treatments with three replications for germination studies as below:

1. T-1 Only Cuscuta seeds without soil
2. T-2 Only Niger seeds without soil
3. T-3 Cuscuta + Niger seeds without soil
4. T-4 Cuscuta seeds with soil
5. T-5 Niger seeds with soil
6. T-6 Cuscuta + Niger seeds with soil

Germination percentage is the proportion of the seeds that germinate from all seeds subject to the right conditions for growth. Germination percentage can be calculated by the formula given below:

$$\text{Germination \%} = \frac{\text{Total no. of seeds germinated}}{\text{Total no. of seeds sown}} \times 100$$

Same size of plastic bowls were taken and equal quantity of seeds (30 Nos.) of both Niger and Cuscuta were distributed in the bowls as per treatment details. Niger seeds were sown with soil, without soil and with Cuscuta seeds in the bowls. In the same way Cuscuta seeds were also sown with soil, without soil and with Niger seeds in the respective bowls. Environment and weathers conditions were same for all the treatments. Germination data were recorded after 4 to 5 days, after 8 to 10 days, after 15 days & later in all the treatments to see the germination and interaction effect in all the bowls. Plant count was also done on the same duration and data were recorded for analysis.

Results and Discussion

Result was revealed that Cuscuta seeds were germinated in all the three treatments i.e. Cuscuta seeds sown with soil, without soil and with Niger seeds. Means in proper humidity, moisture and temperature condition

Cuscuta seeds can also germinate without soil and can infect the host plant when conditions are favourable. Sometime Cuscuta seeds also mix with Niger seeds during sowing and also germinate in a natural ways that Niger seeds does not affect the Cuscuta germination so it cause the major problem during Niger cultivation. Germination data were taken on 5th, 10th and 15th day & later (as in Table.1) and it was shown that more than 60% germination recorded in all the treatments. Treatment T¹ & T³ recorded 70% & 73% germination respectively which clear that if environment condition is favourable than soil is a not required for germination of Cuscuta and it can severely affect the not host crop also. Treatment T⁴ and T⁶ recorded 80% & 83% germination respectively in soil condition which means in field condition germination meets the favourable environment and increase accordingly.

In the same way Niger seeds were also germinated in all the three treatments i.e. Niger seeds sown with soil, without soil and with Cuscuta seeds. Means in proper humidity, moisture and temperature condition. A good germination percentage were recorded in treatment T² & T⁵ i.e. 93% & 97% both without soil and soil condition but germination percentage were reduced to 67% and 73% in the treatment of T³ and T⁶ where Niger was sown with Cuscuta seeds, germination percentage of Niger is reduced up to 20%, which may be due to some chemical reactions or interaction effect of Cuscuta seeds on the Niger which resulted less germination. (Similar study and result were also reported by B.T.S Moorthy *et al* in 2004).

In the field condition when Cuscuta reaches its haustoria stage the control of the Cuscuta is very difficult task and only removal of the infected plant along with Cuscuta can be practiced which result in heavy crop losses.

(Benvenuti *et al.*, 2005). Cuscuta seeds were also germinated without soil in proper moisture condition or suitable environment which is the clear indication of its infestation in the seasonal crops. Sometime Cuscuta seeds may enter in store room or any other places and get germinated in favourable moisture condition and transfer its threads/stems along with the crop materials in the field again resulted in severe crop loss. (Similar study was also done by Gaertner, *et al* in 1950).

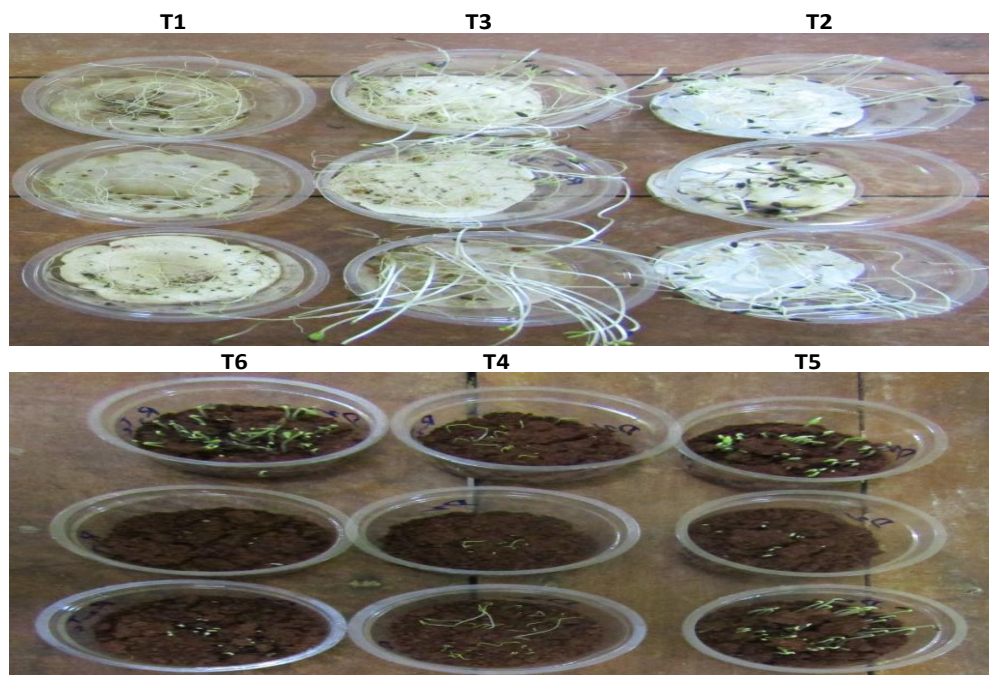
As Niger is the major host for the Cuscuta and it grows and take food through haustoria. Earlier Some theories state that host is required for germination of Cuscuta and than

only it can be infected the crop but in above study it was revealed that Cuscuta can be germination both with host, without host, with soil,without soil and after germination it drastically reduced crop yield in major host Niger and many minor host like Tomato, Bringal, Carrot and others crops so the specific preventive measures should be applied. (Hutchison *et al.*, 1979-80). Management is only achieved using combined preventive, cultural, mechanical and chemical methods that aim at control of existing populations prior to seed production and control of subsequent seedlings. Fields with Cuscuta history need to be monitored frequently, and new plants must be removed as soon as possible. (Cudney *et al.*, 1992)

Table.1 Germination % recorded in different treatments during study

S.No.	Treatments	No. of seeds sown	Observation of germination (in days)	Nos. of seeds germinated	Germination percentage (%)
1.	T1	30 (Cuscuta)	5	18	60
			10	20	67
			15	22	70
2.	T2	30 (Niger)	5	25	83
			10	27	90
			15	28	93
3	T3	30 (Cuscuta) + 30 (Niger)	5	16+18	53+60
			10	18+18	60+60
			15	22+20	73+67
4	T4	30 (Cuscuta)	5	20	67
			10	22	73
			15	24	80
5	T5	30 (Niger)	5	22	70
			10	27	90
			15	29	97
6	T6	30 (Cuscuta) + 30 (Niger)	5	18+20	60+67
			10	20+22	67+73
			15	25+22	83+ 73

Fig.1 Germination of Niger and Cuscuta seeds in different plastic bowls as per given treatment



Preventive management includes planting Cuscuta-free crop seeds, cleaning agricultural machinery before moving from an infested area to a non-infested area, and managing existing populations prior to seed production so as to not spread its seeds. While small infestations can be removed by hand to prevent the production of the seed, the recommendation for controlling extensive infestations is to remove the host plant and, if possible, replant with non-host crops. Cultural practices like planting non-host grass crops (e.g., corn, sorghum), winter crops (e.g., winter wheat, broccoli, legumes), and transplanted trees with bark (e.g., pecan) can be effective in managing Cuscuta in an infested area (Alex *et al.*, 1998). Mechanical control practices like hand-pulling, burning, cutting, or close mowing of the infested plants. Several post-emergence and pre-emergence herbicides are effective for Cuscuta control/ suppression. Common PRE herbicides (applied prior to dodder emergence) for Cuscuta control include Kerb (pronamide), Treflan (trifluralin), and Prowl

(pendimethalin) (Dalei *et al.*, 2014; Dawson *et al.*, 1983).

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