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Effect of organic and inorganic sources of carbon and nitrogen on growth and sclerotial production of *Rhizoctonia bataticola* causing dry root rot of chickpea

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Abstract
Studies on effect of organic and inorganic sources of carbon and nitrogen on growth and sclerotial production of *Rhizoctonia bataticola* causing dry root rot of chickpea was carried out *in vitro* and results indicated that All the carbon and nitrogen sources tested exhibited a wide range of sporulation from poor (+) to excellent (++++). However, carbon sources *viz*., Dextrose, Sucrose and Cellulose recorded excellent (++++) sporulation and nitrogen sources viz., Sodium nitrate, Potassium nitrate and Peptone recorded excellent (++++) sporulation.

Keywords: *R.bataticola*, chickpea, carbon, nitrogen

Introduction

Chickpea is an important *Rabi* crop sown in September – November and harvested in February.The production of chickpea is largely constrained by *Fusarium* wilt (*Fusarium oxysporum* f. sp.*ciceris*); however, recent reports indicated that dry root rot (DRR) is emerging as a potential threat to chickpea production (Ghosh *et al*., 2013, Pande *et al*., 2010 and Sharma *et al*., 2010) [2, 8, 13]. Among the several soil borne fungal diseases of Chickpea, dry root rot caused by *Rhizoctonia bataticola* (Taub.) Butler (*Macrophomina phaseolina* (Tassi.) Goid)) is the most severe disease particularly in the central and southern zone of India and it was first reported from India by (Mitra, 1931) [6]; later, the disease has been reported from most chickpea-growing areas in India and other several countries. It can affect chickpea production, causes considerable yield losses that vary from 5to 50% and may cause 100% losses in susceptible cultivars under favorable condition (Pande *et al*., 2012) [9] and considerable yield losses which may be as high as 50 to 71% (Veena *et al*., 2014a). The disease is more prevalent during hot temperature of 30 to 35°C and low soil moisture conditions (Taya *et al*., 1988; Pande and Sharma, 2010) [17, 8]. Considering the economic importance of disease, present investigation was planned to study the effect of carbon and nitrogen sources on growth and sporulation of *Rhizoctonia bataticola*.

Material and methods

Effect of organic and inorganic sources of carbon

Treatments details

Tr. No	Treatments	Tr. No	Treatments
T_1	Dextrose	T_4	Starch
T_2	Sucrose	T_5	Cellulose
T_3	Mannitol	T_6	Maltose
T_7	Control		

Effect of different carbon source on growth and sporulation of (*R. bataticola)*, carbon sources viz., Dextrose, Sucrose, Mannitol, Starch, Cellulose, Maltose and C- Control were used. For the assessment of suitable carbon source, Richards medium without carbon (50 g/lit) was used as basal stock medium. Sucrose when used @ 5.25 g provides 21.052 g of carbon 100/ml. On this basis for each test carbon source, 200 ml Richards agar medium was prepared in 250 ml capacity glass conical flasks and sterilized in autoclave at 15 lbs/inch2 pressure for 20 min. Autoclaved and cooled Richards agar medium amended separately with various carbon sources was poured (@ 20 ml/plate) in sterilized glass Petri plates (90 mm dia.) and allowed to solidify at room temperature. On solidification of the medium, plates (three plates / carbon source / replication) were inoculated by placing in the centre 5 mm mycelial disc of actively growing 7 days old pure culture of *R. bataticola* (Rb-6isolate). Each carbon source was replicated thrice. Carbon control (Richard's medium without any carbon source) was also maintained. Plates were incubated at room temperature (27 + 20C). Observations on colony diameter and sporulation were recorded after at a week and two weeks of incubations, respectively.

Effect of organic and inorganic sources of nitrogen
Treatments details

Tr. No.	Treatments	Tr. No.	Treatments
T_1	Calcium nitrate	T_4	Mg nitrate
T_2	Sodium nitrate	T_5	Potassium nitrate
T_3	Ammonium nitrate	T_6	Peptone
T_7	Control		

Effect of different nitrogen sources on growth and sporulation of (*R. bataticola),* nitrogen sources viz., Calcium nitrate, Sodium nitrate, Ammonium nitrate, Mg nitrate, Potassium nitrate, Peptone and C- Control were used. For the assessment of suitable nitrogen source, Richards medium without nitrogen (10 g / lit) was used as basal stock medium. As the nitrogen provides 0.872 of nitrogen through 1.386 g/100 ml. For each test nitrogen source, 200 ml of Richards agar medium was prepared and poured in glass Conical flasks (250 ml cap.) and sterilized in autoclave at 15 lbs/inch2 pressure for 20 min. Autoclaved and cooled medium was poured (@ 20 ml/plate) in sterilized glass Petri plates (90 mm dia.) and allowed to solidify at room temperature. On solidification of the medium, plates (three plates/nitrogen source/replication) were inoculated by placing in the centre 5 mm mycelial disc of actively growing 7 days old pure culture of *R. bataticola* (Rb-6isolate). Each nitrogen source was replicated thrice. Nitrogen control (with at any source of nitrogen) was also maintained. Plates were incubated at room temperature (27 + 2 0C). Observations on colony diameter and sporulation were recorded after ten days of incubation. The number of sclerotia was observed microscopically and graded as below. (Tandel and Sabalpara, 2011) [16]

S. No.	Score	Grade	Number (Sclerotia/microscopic field) at 100x
1	++++	Excellent	>50
2	+++	Good	30-50
3	++	Fair	21-30
4	+	poor	10-20
5	-	No sporulation	-

Results and discussion

Effect of organic and inorganic sources of carbon and nitrogen on growth of *Rhizoctonia bataticola*

Effect of organic and inorganic sources of carbon

The capacity of the fungus to utilize various carbon sources is governed by its ability to produce enzymes. These enzymes convert complex carbon compounds into simpler forms, which are subsequently utilized for growth and reproduction. All of the six carbon sources (Table 1, Fig. 1, PLATE I) tested encouraged better growth of *R. bataticola* except carbon control.

Table 1: Effect of various Carbon sources on growth and Sclerotial production of *R. bataticola*

S. No.	Carbon Sources	Mean colony diameter (mm)*	Colony colour	Sclerotial production
T_1	Dextrose	86.58	Whitish black	++++
T_2	Sucrose	81.28	Whitish	++++
T_3	Mannitol	72.64	Whitish	+
T_4	Starch	71.49	Whitish black Cottony	++
T_5	Cellulose	51.69	Whitish black Cottony	++++
T_6	Maltose	41.43	Black	++
T_7	Control	26.00	Black	-
SE± (m)		0.51		
CD at 1% (m)		2.13		

++++ Excellent, +++ Good, ++ Fair, + Poor, - No.

Plate I: Effect of various Carbon sources on growth and Sclerotial production of *R. bataticola*

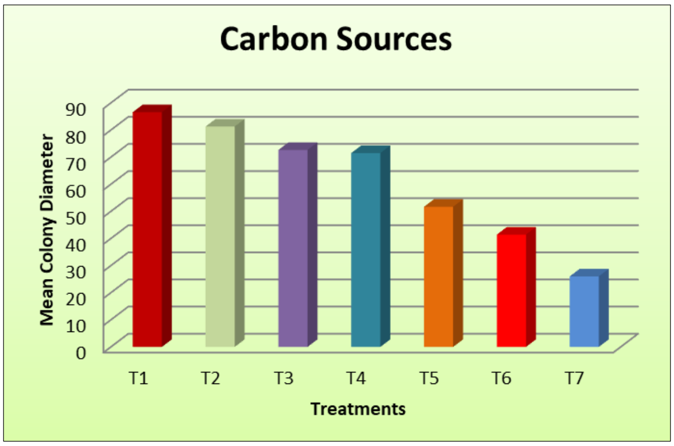

Fig 1: Effect of organic and inorganic sources of carbon

However, significantly highest mean mycelial growth (86.58 mm) was recorded with Dextrose. The second and third best carbon sources found were Sucrose (81.28 mm) and Mannitol (72.64 mm). Rest of carbon sources recorded radial mycelia growth in the range of 41.43 (Maltose) to 71.49 mm. (Starch). All the carbon sources tested exhibited a wide range of sporulation from poor (+) to excellent (++++). However, carbon sources viz., Dextrose, Sucrose and Cellulose recorded excellent (++++) sporulation. Rest of carbon sources exhibited good (+++) to Poor sporulation (+).

The result in the present study is in agreement with the findings of Salunke *et al*., (2009) [11] and Thombre & Kohire (2018) [18]. The sources of carbon viz., Sucrose, Fructose, Dextrose, Maltose, Glucose, and D - Galactose were reported to support maximum growth and sporulation in *M. phaseolina*/ *R. bataticola* earlier as reported by several workers viz. Shanmugam and Govindaswamy, (1973) [12]; Hooda and Grover (1983) [3]; Diazfranco (1984) [1]; Mehta and Gupta (1992) [7]; Priya Santosh, (2008) and Kumar and Gaur (2010) [4]

Effect of organic and inorganic sources of nitrogen

Table 2: Effect of various nitrogen sources on growth and Sclerotial production of *R. bataticola*

S. No.	Nitrogen Sources	Mean colony diameter (mm)*	Colony colour	Sclerotial production
T_1	Calcium nitrate	62.24	Black	++
T_2	Sodium nitrate	86.51	Whitish black	++++
T_3	Ammonium nitrate	50.42	Whitish	++
T_4	Mg nitrate	60.00	Grey	+++
T_5	Potassium nitrate	84.40	Whitish black	++++
T_6	peptone	66.60	Whitish Cottony	++++
T_7	Control	15.33	Black	-
	SE± (m)	1.26		
	CD at 1% (m)	5.22		

++++ Excellent, +++ Good, ++ Fair, + Poor, - No.

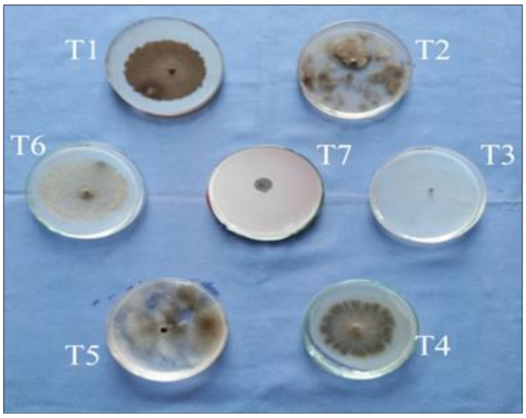

Plate II: Effect of various nitrogen sources on growth and Sclerotial production of *R. bataticola*

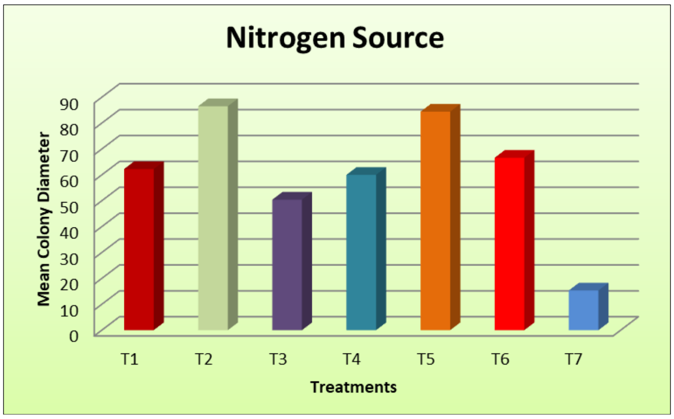

Fig 2: Effect of organic and inorganic sources of Nitrogen *bataticola*

In the present study to determine the utilization of different nitrogen compounds (Table 2, Fig. 2 & PLATE II) by *R. bataticola*, it was observed that sodium nitrate was found most suitable and encouraged maximum radial mycelial growth (86.51 mm). The second-best nitrogen source was found Potassium nitrate (84.40 mm), followed by Peptone (66.60 mm), and Mg nitrate (60.00 mm).

All the nitrogen sources tested exhibited a wide range of sporulation from poor (+) to excellent (++++). However, nitrogen sources viz., Sodium nitrate, Potassium nitrate and Peptone recorded excellent (++++) sporulation. Rest of nitrogen sources exhibited good (+++) to Poor sporulation (+).

The result in the present study is in agreement with the finding of Salunkhe *et al*., (2009) [11] reported that among six carbon sources, highest growth was obtained in dextrose followed by sucrose, mannitol, starch, maltose and cellulose. Sclerotial production in cellulose was maximum followed by dextrose, sucrose, maltose, starch while, it was minimum in mannitol. Sodium nitrate proved better nitrogen source for growth and sclerotial formation than ammonium nitrate. The sources of nitrogen *viz*., potassium nitrate and sodium nitrate, ammonium nitrate and peptone were reported to support maximum growth and sporulation in *M. phaseolina* earlier as reported by several workers Shanmugam and Govindaswamy (1973) [12], Lakhpale *et al*., (1995); Sharma and Tripathi (2002) [14]; Sharma and vishnupriya (2006) [15]; Kumar and Gaur, (2010) [4] Thombre & Kohire (2018) [18].

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