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Efficiency of button spent mushroom *Substrate* for managing chick pea collar rot incited by *Sclerotium rolfsii*

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Abstract
Sclerotium rolfsii is a soil borne plant pathogen causing root rot, stem rot, collar rot, wilt and foot rot diseases on more than 500 plant species of agricultural and horticultural crops throughout the world. SMS also possesses good bio-control activity against certain foliar and soil borne diseases and potential to bioremediate several agricultural grade fungicides and pesticides. The experiment was conducated at different concentrations of spent mushroom substrate amended with soil and *Sclerotium rolfsii* in pot culture. The observations to be recorded disease incidence, phenotypic parameters and disease severity index.

Keywords: SMS (spent mushroom substrate), disease incidence, phenotypic parameters and disease severity index

Introduction
Chickpea is known in this country since ancient times. It is said to be one of the oldest pulses known and cultivated in Asia and Europe. India is the major chickpea growing country of the world and in India the major producing states are Madhya Pradesh, Rajasthan, Maharashtra, Uttar Pradesh, Karnataka and Andhra Pradesh together contributing to 90 per cent of the area and 91 per cent of the production in the country. Among diseases collar rot caused by *Sclerotium rolfsii* sacc is one of the several fungal diseases affecting this crop and is reported almost all over the world wherever chickpea is grown (Nene *et al*., 1984) [12]. *Sclerotium rolfsii*, is a soil borne plant pathogenic fungus causing large economic losses (Kokub *et al*., 2007) [8]. Seedling mortality from 54.7 to 95.0% in chickpea due to infection of *Sclerotium rolfsii* has been reported by (Mathur & Sinha 1970) [10]. In order to minimize infection, only practicable and cost-effective control is selection of disease resistant cultivars (Akram *et al*., 2008) [1]. Spent mushroom compost (SMC), otherwise known as the spent mushroom substrates, is the leftover of wastes after different flushes of mushrooms have been harvested. Several agro industrial wastes could be used to prepare mushroom composts. These growing substrates may be composed from different wastes materials such as sawdust, rice straw, bedded horse manure, cotton wastes, paper wastes, cocoa shells, wheat straw, maize husks and various other wastes (Jonathan *et al*., 2011) [7]. The abundance of mushroom compost, as well as its antagonistic nature to fungi, made it an ideal candidate to blend with landscape mulch to suppress fungi without the use of fungicides (Donald D.*et al*., 2005) [4]. Higher levels of phenolic compounds were found in spent of oyster than button mushroom. The phenolic compounds present in SMC have antimicrobial activity, which could be an effective bio-control of *Meloidogyne spp.* on tomato (Aslam and Saifullha. 2013) [2]. Spent mushroom compost used at different amounts used against *Sclerotium rolfsii.*

Material and Methods
The following material and methods were used to "Study on comparative efficiency of spent mushroom for managing wilt and wilt like diseases of chickpea" Experiment and related studies conducted in the (AICRP on Chickpea, Department of plant breeding and genetics) JNKVV, Jabalpur.

Seed source: Chickpea, Variety: JG 62

Spent mushroom substrate
Two year old spent button mushroom substrate (SMS) obtained from mushroom production unit, Department of plant pathology, JNKVV, Jabalpur (M.P.). Sterilized soil and spent

mushroom were mixed in four different combination 25%, 50%, 75%, 100% and filled in the sterilized pots.

Treatment combination

T1 25% SMS + 75% soil, T2 50% SMS + 50% soil, T3 75% SMS + 25% soil, T4 100% SMS + inoculums, T5 Treated control (control + inoculum) and T6 Untreated control (control without inoculum).

Pathogenicity test and mass multiplication of *Sclerotium rolfsii*

Mass culture technique for *Sclerotium rolfsii* obtained from infected plant part were tested pathogenic behaviour. The inoculum of *Sclerotium rolfsii* mass multiplied on sterilized sorghum grains. 250 gm sorghum grains was filled in bags and sterilized in an autoclave. The sterilized mixture was inoculated with 7 days old culture of pathogen (*Sclerotium rolfsii*) and incubated at 25±1^{0}C for 25 days. Thus profuse and dense growth of fungal mycelium and Sclerotia was obtained. The inoculum was thoroughly mixed in sterilized soil (sand + soil) (1:1) @ 25 g/ kg soil (Gupta, 2001) [5]. The inoculated soil filled in pots @ 3 kg/ pot. After inoculation the soil was incubated at room temperature for 15 days. Pots were filled with this infested soil. For determining the pathogenicity, seeds were surface sterilized with mercuric chloride 1:1000 for 30 seconds, were sown in pots. These pots were kept in natural condition, chickpea seeds sown in uninoculated sterilized soil served as control.

Effect of spent mushroom on growth parameters

Five seeds were sown in sterilized earthen pots filled with sterilized soil. Germination percentage was recorded. Plant height (cm), pod weight (g), seed weight (g) were recorded at maturity.

$$\text{Germination (\%)} = \frac{\text{Total number of seed germinated}}{\text{Total number of seed sown}} \times 100$$

Germination percentage and pre and post emergence mortality were recorded. Per cent mortality will be calculated by using the following formula;

$$\text{Disease incidence} = \frac{\text{Number of diseased plants}}{\text{Total number of seedlings}} \times 100$$

Disease severity index

Determination of disease severity index: The disease severity index was calculated as described by Bhattacharya *et al*., (1985) [3]. The extent of infection by *Rhizoctonia bataticola* was indicated by the presence of dark brown lesion and also by the presence of microsclerotia of the fungus on root systems. Healthy and infected plants were divided into four groups as follows:

Healthy plants 1 = No root rot symptoms,

Slightly infected plants 2 = Dark brown to black spots on collar as well as on primary roots.

Heavily infected plant 3 = Weak and stunted plants with rotting of roots,

Plants dead 4 = Dead and fallen plants

Lesions on the entire root system and the disease severity index

(D.I.) were calculated as follows:

$$\text{D.I.} = \frac{0\,(\text{Hn}) + 1\,(\text{Sn}) + 2\,(\text{Hn*}) + 3\,(\text{Dn})}{\text{Total number of plants examined}} \times 100$$

Where,

(Hn)= Number of healthy plants

(Sn)= Number of slightly infected plants

(Hn*)= Number of heavily infected plants

(Dn)= Number of dead plants (Kumar *et al*., 2007) [9]

Results and Discussion

Table 1: Effect of spent mushroom substrate and their combinations on collar rot (*Sclerotium rolfsii)* disease incidence and phenotypic parameters

Treatment	Germination%	Plant height (cm)	No. of pods/plant	Pod weight/plant (gm)	Seed weight/plant (gm)	Disease incidence (%)
25% SMS + 75% soil	84.00	48.20	9.20	20.45	18.19	28.00
50% SMS + 50% soil	88.00	50.60	12.00	21.79	19.80	24.00
75% SMS + 25% soil	92.00	50.40	19.00	23.00	21.02	24.00
100% SMS +inoculum	88.00	52.40	20.60	25.26	23.53	20.00
Treated control	72.00	48.00	9.20	15.47	12.79	44.00
Untreated control	96.00	52.20	19.00	26.71	26.39	20.00
SE(m)	4.61	1.10	0.75	0.86	0.89	5.29
C.D.	13.56	3.25	2.22	2.58	2.62	3.22

Mean of 5 replications

Germination percentage

Data presented in Table 1 showed that all the treatments significantly increased the germination percentage as compared to treated control (72.00%). Among the treatment minimum germination per cent 84.00% was observed in treatment 25% SMS + inoculum followed by 88.00% at 50% SMS + 50% soil, 100% SMS + inoculum, 92.00% at 75% SMS + 25% soil. Maximum germination percentage was recorded 96.00% at untreated control.

Plant height

Data presented in Table 1. were recorded at the time of maturity showed that plant height was significantly increased in all the treatments except 48.20 cm in treatment 25% SMS + 75% soil Maximum height was recorded in treatment 100% SMS + inoculum (52.40cm) followed by untreated control (52.20cm) followed by 50.60cm in treatment 50% SMS + 50% soil and minimum plant height significantly increased 50.40cm in treatment 75% SMS + 25% soil as compared to treated control 48.00 cm.

Number of pod per plant

Data presented in Table 1 showed that Number of pods per plant in all the treatments were significant except in treatment 25% SMS + 75% soil (9.20) as compare to treated control (9.20). Maximum number of pods 20.60 was recorded in

treatment 100% SMS + inoculum followed by untreated control (19.00) and treatment 75% SMS + 25% soil, minimum number of pods was recorded 12.00 in treatment 50% SMS + 50% soil as compared to treated control (9.20).

Pod weight

Data presented in Table 1 showed that among the treatments pod weight varied from 20.45 to 26.71 gm/plant as compared to in treated control (15.47gm/plant). All treatments showed significant increase pod weight, maximum pod weight was recorded in untreated control (26.71 gm) followed by treatments 100% SMS + inoculum (25.26 gm), 75% SMS + 25% soil (23.00 gm), 50% SMS + 50% soil (21.79 gm), followed by 20.45 gm at 25% SMS + 75% soil.

Seed weight

Data presented in Table 1 for seed weight indicated that untreated control (26.39 gm) was highly significant as compared to treated control (12.79 gm), followed by treatments 100% SMS inoculum (23.53 gm), 75% SMS + 25% soil (21.02 gm), 50% SMS + 50% soil (19.80 gm) and minimum seed weight 18.19 gm was recorded in treatment 25% SMS + 75% soil (18.19 gm) as compared to treated control (12.79 gm).

Disease incidence

Table 1 Disease incidence caused by *Sclerotium rolfsii* to the susceptible variety JG - 62 of chickpea was highly significant at treatment 100% SMS + soil (20.00%) and in untreated control (20.00%) as compared to treated control (44.00%), followed by treatment 75% SMS + 25% soil (24.00%) and by 50% SMS + 50% soil (24.00%), and maximum disease incidence 28.00% showed by treatment 25% SMS + 75% soil as compared to treated control (44.00%).

Table 2: Disease severity index of *Sclerotium rolfsii.*

Treatments	*Sclerotium rolfsii*
25% SMS + 75% soil	72.00
50% SMS + 50% soil	60.00
75% SMS + 25% soil	60.00
100% SMS + inoculums	48.00
Treated control	100.00
Untreated control	52.00
SE(m)	8.48
C.D.	24.91

Sclerotium rolfsii

The results presented in Table 2 lowest percent disease incidence of 48.00% of collar rot disease (*S. rolfsii*) incidence, in treatment 100% SMS + inoculum and 52.00% in untreated control as compared to treated control (100.00%). Maximum disease severity was recorded in treatment 25% SMS + 75% soil followed by 50% SMS + 50% soil as compared to control.

Table 3: Analogy of assessment of various factors against *Sclerotium rolfsii*

Treatments	Control factor	Efficiency	Relationship factor
25% SMS + 75% soil	0.66	0.33	0.66
50% SMS + 50% soil	0.53	0.46	0.52
75% SMS + 25% soil	0.53	0.46	0.52
100% SMS + inoculum	0.46	0.53	0.45
Treated control	1.00	0.00	0.99
Untreated control	0.46	0.53	0.52
SE(m)	0.06	0.06	0.06
C.D.	0.18	0.18	0.18

Mean of 5 replications

Efficiency of treatments

Data presented in Table 3 showed that treatment 100% SMS + inoculum and untreated control were most effective against *Sclerotium rolfsii* as compared to treated control, followed by treatment 75% SMS + 25% soil and by treatment 50% SMS + 50% soil, minimum efficiency was recorded in treatment 25% SMS + 75% soil against *Sclerotium rolfsii* as compared to treated control.

Impact of spent mushroom treatments was studied with respect to seed germination, morphological traits and disease incidence to *Sclerotium rolfsii*, the discussion pertaining has been furnished under the following heads. SMS play role in its further de-composition but also exert antagonism to the normal pathogens surviving and multiplying in the soil ecosystem, restricts the root knot infections of tomato plant, presence of Pseudomonas and Bacillus present in the SMS exert antagonism to a number of soil pathogens (Mohapatra and Behera 2011) [11]. SMS treated plant showed high growth rate with maximum shoot and root length as compared to control in tomato plant (Jonathan *et al*. 2011) [7]. SMS for the control of *Fusarium* wilt in tomato and also showed that spent mushroom compost was a soil amendment Harender Raj and Kapoor I.J. (1997) [6]. SMS play role in its further de-composition but also exert antagonism to the normal pathogens surviving and multiplying in the soil ecosystem, restricts the root knot infections of tomato plant, presence of Pseudomonas and Bacillus present in the SMS exert antagonism to a number of soil pathogens (Mohapatra and Behera 2011) [11].

Conclusion

SMS amendment in soil significantly increased the Germination percentage, Plant height, No. of pods/plant, Seed weight/plant Disease incidence and Disease severity index

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