



ISSN (E): 2277- 7695  
ISSN (P): 2349-8242  
NAAS Rating: 5.23  
TPI 2022; SP-11(2): 872-874  
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Received: 13-12-2021  
Accepted: 17-01-2022

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## Sclerotial status of pearl millet seed samples in Rajasthan

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### Abstract

The present investigation on, "sclerotial status of pearl millet seed samples in Kharif 2019 in Rajasthan". Sclerotia are dormant stage of *Claviceps fusiformis* which caused ergot of pearl millet pearl. The study was carried out to observed sclerotia of pathogen and find out the sclerotia per cent in collected samples. The maximum mean sclerotia per cent (on weight basis) was found in Alwar tehsil (3.44 per cent) and minimum was found in Phulera tehsil (1.20 per cent). The over all mean sclerotia per cent recorded was 2.63 per cent.

**Keywords:** *Claviceps fusiformis*, ergot, sclerotia, pearl millet, samples

### Introduction

Pearl millet (*Pennisetum glaucum* (L.) R.Br.) is the extensively drought tolerant warm season cereal grown on 27 million ha in some of the harsh, dry-semi-arid and arid tropical environments of sub-Saharan Africa and South Asia. In India third after rice and wheat grown area under pearl millet, among cereals. It is more tolerant to high temperatures than any other cereal. The optimum temperature for the germination of bajra seed is from 23 to 32 °C. 500-800 mm rainfall is optimum for pearl millet production. It is a highly cross-pollinated species, with outcrossing rates of more than 85 per cent, because of its protogynous nature of flowering. This stage is favorable for ergot incidence. It uses mainly for cattle feed, poultry, starch and alcohol industry. It is noted that demand for bajra from the health-conscious food products industry is increasing as it contains more fibre and is good for heart and diabetic patients. Pearl millet is also an important fodder crop in the summer season, as most of the other crops cannot withstand hot temperatures. However, there are some biotic and abiotic constraints in cultivation of bajra, such as ergot, downy mildew, smut, shoot fly, stem borer, drought, extreme moisture and heat moisture stress. (Reddy *et al.*, 2013) [11].

Pearl millet production is concentrated in Rajasthan, Maharashtra and Gujarat which account for 70 per cent of production in India. Bajra is usually grown as a dryland dual purpose grain and fodder crop although it is sometimes irrigated in India, particularly the summer crop grown mainly as a forage crop. (Basavaraj *et al.*, 2010) [3].

Today, ergot is one of the principal factors preventing the realization of the high grain yield potential of bajra hybrids in Africa and Asia. In addition, it reduce the quality of the grain in an infected crop by contaminating it with the alkaloid containing sclerotia of ergot (Krishnamachari and Bhat, 1976) [6, 4]. Ergot, caused by *C. fusiformis* loveless, was a minor disease of pearl millet (*Pennisetum americanum* (L.) Leeke) in India until the early 1970s when it became a serious problem in crops of the recently developed and adopted commercial F1 hybrids (Arya and Kumar, 1976, Ramkrishnan, 1971 and Thakur and Williams, 1980) [1, 14, 10]. *C. fusiformis* produces two types of conidia: macroconidia and microconidia, both in culture and in honeydew on infected pearl millet panicles. Macroconidia hyaline, fusiform, unicellular, 12.0-26.5x2.5-6.0 µm, producing 1-3 germ tubes from their ends or sides. Microconidia hyaline, globular, unicellular, 2.5-11.0x1.0-5.0µm, producing only one germ tube. Both macroconidia and microconidia are able to produce additional microconidia in chains from conidiophores formed by the germ tubes (Prakash *et al.*, 1983) [9]. Sclerotia elongate to globose, 3.6-6.1 x 1.3-1.6 mm, pale to dark brown, with or without conidia-containing cavities Germination by 1-16 fleshy purplish stipes, 6-26 mm long, each bearing apical globular capitulum, light to dark brown with numerous perithecial ostioles (Thakur *et al.*, 1984) [13].

Sclerotia of African and Indian isolates of *C. fusiformis* from pearl millet contain agro-clavine and elymoclavine as the main alkaloid components; minor or trace components are chanoclavine, setoclavine, penniclavine and, occasionally, festuclavine. Both also readily produce clavines in submerged culture *in vitro* (Banks *et al.*, 1974, Bhat *et al.*, 1976, Singh and Husain, 1977, Kumar and Arya, 1978) [2, 12, 1, 7].

The *Claviceps* genus caused ergot disease in grass inflorescences. The term “ergot” refers to sclerotia which is the dark fungal structure produced within the floret. The genus *Claviceps* consists of a unique group of species, infecting only the ovaries of grasses and produced sclerotia. Because *Claviceps* genus are not able to penetrate through closed glumes in cross-pollinated crops. (Miedaner and Hartwig, 2015)

The ergot alkaloids can cause severe health related problems in both humans and animals. Up to the 19<sup>th</sup> century, prior to the introduction of grain standards for ergot, the sclerotia were ground up with rye grains and consumed as flour and baking. When ergot infected food consumed caused “ergotism” disease. Strict threshold level are available in the European Union for soft and durum wheat with less than 0.05 per cent (500 mg·kg<sup>-1</sup> for human consumption) by weight of sclerotia and for animal feed, less than 0.1 per cent of sclerotia is usually used as a threshold for all cereals. (European Union Commission Regulation, 2008) [5].

**Materials and Methods**

Ten farmers of two villages of each tehsil and in each districts, five tehsils will be selected from 3 major pearl millet growing districts (Jaipur, Ajmer and Tonk) of Rajasthan. The selection of two villages from each tehsil was made randomly. The seed samples were collected during the crop growth period from August 25 to September 25, 2019.

The seed samples of hybrids / composite of Pearl millet were collected from farmers previously stored seeds in their storehouse. Seed samples were collected from ergot severity surveyed places and farmers of Rajasthan in 2019. One hundred gram seeds of each sample were taken and isolated sclerotia from each sample. Weight of sclerotia was taken out of each sample separately and calculated weight per cent of sclerotia per hundred gram of seed sample and mean of each composite sample used by given below formula.

$$\text{Weight per cent of sclerotia in sample} = \frac{\text{weight of sclerotia in gram}}{\text{Hundred gram of seed sample}} \times 100$$

$$\text{Mean of composite sample} = \frac{\text{sum of weight per cent of ten sample of each tehsil}}{10}$$

**Results and Discussion**

It is evident from Table 1 that mean sclerotia per cent (on weight basis) in seed samples was observed in tehsils of three districts (Jaipur, Alwar and Tonk) of Rajasthan. In which maximum mean sclerotia per cent were observed in samples of Alwar (3.44%) followed by Malpura (3.35%) > Jhotwara (3.33%) > Shahpura (3.31%) > Chomu (3.25%) > Kotputli (3.02%) > Behror (2.75%) > Todaraisingh (2.71%) > Niwai (2.48%) > Uniara (2.47%) > Kishangarh Bas (2.30%) > Tijara (2.04%) > Ramgarh (2.04%) > Tonk (1.56%) > Phulera (1.20%). The maximum sclerotia per cent (7.00%) were observed in sample number one. In the collected samples average sclerotia per cent ranged from 0.00 to 7.00 per cent. The over all mean sclerotia per cent recorded was 2.63 per cent.

**Table 1:** Per cent of sclerotia of *C. fusiformis* in per cent sclerotia (in 100 gram seed samples) of pearl millet collected during survey

S. No.	District	Tehsil	Village	Sclerotia per cent (on weight basis) in collected samples and sample No.					Mean of Sclerotia %
1.	Jaipur	Jhotwara	Hathoj	7.00 (1)	1.50 (2)	0.00 (3)	2.90 (4)	4.90 (5)	3.33
			Kalwar	3.90 (6)	4.50 (7)	3.00 (8)	4.50 (9)	4.60 (10)	
		Chomu	Baga ka bas	5.50 (11)	6.50 (12)	2.60 (13)	5.00 (14)	1.00 (15)	3.25
			Deopura	0.80 (16)	1.50 (17)	3.50 (18)	1.50 (19)	4.60 (20)	
		Kotputli	Beri	0.00 (21)	4.50 (22)	3.00 (23)	3.20 (24)	6.00 (25)	3.02
			Gopalpura	2.90 (26)	5.10 (27)	1.00 (28)	0.50 (29)	4.00 (30)	
		Phulera	Badhal	1.25 (31)	0.00 (32)	0.25 (33)	2.75 (34)	1.20 (35)	1.20
			Haripura	0.00 (36)	5.00 (37)	1.25 (38)	0.00 (39)	0.25 (40)	
		Shahpura	Amarsar	1.00 (41)	3.75 (42)	5.00 (43)	6.20 (44)	1.10 (45)	3.31
			Tejpura	5.25 (46)	2.00 (47)	3.00 (48)	1.75 (49)	4.00 (50)	
2.	Alwar	Alwar	Dadar	2.70 (51)	5.70 (52)	0.00 (53)	3.50 (54)	4.00 (55)	3.44
			kairwara	3.00 (56)	2.80 (57)	3.70 (58)	4.00 (59)	5.00 (60)	
		Behror	Doomroli	0.00 (61)	3.00 (62)	2.10 (63)	4.50 (64)	4.10 (65)	2.72
			Fatehpura	3.10 (66)	2.25 (67)	3.00 (68)	2.00 (69)	3.10 (70)	
		Ramgarh	khoh	5.10 (71)	1.25 (72)	0.00 (73)	3.00 (74)	1.00 (75)	2.04
			Peeproli	2.50 (76)	2.25 (77)	2.00 (78)	1.25 (79)	2.00 (80)	
		Kishangarh Bas	sekhpur	4.20 (81)	1.00 (82)	4.75 (83)	1.50 (84)	2.00 (85)	2.30
			Kherla	1.00 (86)	0.00 (87)	2.50 (88)	3.50 (89)	2.50 (90)	
		Tijara	mosampur	0.00 (91)	4.00 (92)	3.00 (93)	2.40 (94)	5.00 (95)	2.27
			Ladiya	2.50 (96)	2.25 (97)	2.00 (98)	1.00 (99)	0.50 (100)	
3.	Tonk	Tonk	Alipura	0.00 (101)	5.25 (102)	1.90 (103)	2.50 (104)	0.00 (105)	1.56
			Lamba	2.90 (106)	0.90 (107)	0.00 (108)	0.25 (109)	1.90 (110)	
		Malpura	Amarpura	1.90 (111)	0.00 (112)	5.00 (113)	5.70 (114)	3.00 (115)	3.35
			Sitarapura	2.00 (116)	2.00 (117)	4.90 (118)	5.00 (119)	4.00 (120)	
		Niwai	Banshipura	2.00 (121)	1.29 (122)	4.50 (123)	2.00 (124)	3.00 (125)	2.48
			Govindpura	3.57 (126)	2.90 (127)	0.00 (128)	3.50 (129)	2.00 (130)	
		Uniara	Bilota	3.20 (131)	0.00 (132)	2.60 (133)	4.00 (134)	5.50 (135)	2.47
			Mandawara	2.60 (136)	1.00 (137)	3.20 (138)	0.00 (139)	2.60 (140)	
		Todaraisingh	Bagri	0.00 (141)	2.75 (142)	4.90 (143)	2.00(144)	2.80 (145)	2.71
			Rampura	1.00 (146)	4.00 (147)	3.00 (148)	3.75 (149)	2.90 (150)	
Over all mean of sclerotia per cent = 2.63									

Sclerotia of ergot reduces the quality of the grain in an infected crop by contaminating it with the alkaloid (Bhinde and Sheth 1957, Patel *et al.*, 1958, Ramkrishnan 1971, Bhat, Roy and Tulpule 1976)<sup>[10]</sup>.

The seed samples of hybrids / composite of Pearl millet were collected from farmers previously stored seeds in their storehouse. Seed samples were collected from ergot severity surveyed places and farmers of Rajasthan in 2019. The maximum mean sclerotia per cent (on weight basis) was found in Alwar tehsil (3.44 per cent). Moderately found in Uniara tehsil (2.47 per cent) and Niwai tehsil (2.48 per cent) and minimum was found in Phulera tehsil (1.20 per cent). The over all mean sclerotia per cent recorded was 2.63 per cent. The observation of present studies are found similar with the reports of the earlier worker where sclerotia from Aurangabad and ICRISAT Centre were the largest (5× 2.5 mm) and heaviest (1.4g/100 sclerotia), and from Mysore the smallest (3 × 2 mm) and lightest (0.4 g/100 sclerotia). The average number of cavities (furrows) was minimum in the Mysore collection (4/sclerotium) and maximum in the Kovilpatti collection (15/sclerotium). Large variations occurred in size and ratios between the number of macro- and microconidia residual on sclerotia from different locations. Time to initiate of germination of macroconidia from sclerotia in sterile distilled water at 25 °C varied from 24 hours in Aurangabad and Jobner collections to 50 hours in the Kovilpatti collection. The macroconidia of the Pune collection did not germinate. The isolates differed in growth characteristics on Kirchoff's agar at 25 °C. In a pathogenicity test using 10-day-old culture inoculum in six pearl millet genotypes (3 resistant and 3 susceptible), some isolates were more virulent than others (Chahal *et al.*, 1985).

### Conclusion

The maximum mean sclerotia weight per cent was observed in Alwar tehsil (3.44 per cent).

### Acknowledgement

The authors sincerely thanks to the Dean and Head, Department of Plant Pathology, Sri Karan Narendra Agriculture University, Jobner, for providing the necessary facilities to conduct the investigations.

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