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SCREENING OF PIGEONPEA [*CAJANUS CAJAN* (L.) MILLSP.] GENOTYPES AGAINST POD INFESTING PEST COMPLEX AND PHYSIOLOGICAL DISORDER

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ABSTRACT

Fifteen medium maturity group pigeonpea genotypes were screened against pod pest complex and physiological disorder. Perusal of data revealed that genotypes were neither free from pod pest infestation nor from physiological disorder. Pod damage due to pod fly, plume moth, gram pod borer and pod bug significantly ranged from (2.11 to 8.79%), (3.63 to 7.88%), (0.90 to 3.63%) and (0.90 to 11.81%) respectively. Whereas grain damage from (0.65 to 2.63%), (1.12 to 2.56%), (0.34 to 1.23%) and (0.46 to 3.82%) respectively. The pod and grain damage due to physiological disorder varied from (2.11 to 8.18%) and (0.94 to 3.23%) respectively. On average grain damage it is apparent that plume moth (1.67%) was ranked first followed by pod bug (1.47%), pod fly (1.41%) and gram pod borer (0.76%) respectively.While physiological disorder damage was highest (1.74%). Further on grain damage counts genotypes Khargone-2 found least susceptible to pod fly (0.65%) and plume moth (1.39%), WRG-97 was found to be least susceptible to pod fly (1.03%) and pod borer (0.47%).Both genotypes recorded (0.98%) and (0.94%) grain damage respectively, found least susceptible to physiological disorder too. The highest grain yield 2732.16 kg/ha obtained in genotype BDN-2001-6 shown its superiority over check-'Khargone-2'.

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INTRODUCTION

Pigeonpea is important legume crop grown world over, mostly in tropical and sub-tropical countries for grains, green manuring, fodder and forage as sole crop, intercrop, mixed crop and in sequential cropping systems. The countries with notable pigeonpea production are India, Nepal and Myanmar in Asia, Malawi and Uganda along with some other countries in eastern Africa and the Dominican Republic in the Americas (Ahlawat and Shivakumar, 2006).

In India pigeonpea occupied around 3.89 million ha area with production of 3.02 million tonnesand productivity 776 kg/ha (DAC, 2014). In the country, the crop is extensively grown in Uttar Pradesh, Madhya Pradesh, Maharashtra, Karnataka, Andhra Pradesh and Gujarat. Pigeonpea is a rich source of protein (21.71%) and supplies a major share of protein requirement of the vegetarian population of the country, besides it is also a rich source of iron, iodine and essential amino acids like arginine, cystine and lysine (Singh *et al.,* 2007).The average productivity of pulses in India is 625 kg/ha to meet the growing demands, this needs to be increased at least by 28 per cent in the next 10 years (Nadarajan, 2009). Despite being the largest producer, India is the largest importer of the pigeonpea in the world. It is estimated that during 2014-15, India imported about 4.7 million tonnes of pigeonpea to satisfy the domestic consumption pressure from the countries Myanmar, Tanzania and Kenya (Anonymous,2016)

Abiotic and biotic stresses are the most limiting factors in pigeonpea production. Among the biotic pressures, low yields of crop are due to attack of pod pest complex namely pod fly, plume moth, pod bug and gram pod borer. These pests and physiological disorder cause adequate economic damage leading to very low yield levels of 500 - 800 kg/ha as against the potential yield of 1800 - 2000 kg/ha (Lal *et al.*, 1997). Insect pests belonging to 6 orders and 16 families infesting pigeonpea from flowering to pod maturity stage causes maximum damage (Srilaxmi *et al.*, 2010). Yadav and Chaudhary (1993) recorded 13.6% pod and 5.3% grain and 9.3% pod and 3.3% grain damage due to gram pod borer and pod fly respectively. Several researchers have been emphasized on utilization of host plant resistance to tackle the problems of low yield due to pod pest complex as well as against physiological disorder in pigeonpea. Keeping these things in mind present study was conducted to evaluate the infestation of pod pest complex and physiological disorder against different pigeonpea genotypes of medium maturity group.

MATERIALS AND METHODS

The studies were carried out at experimental field of Department of Entomology, Adhartal, J. N. Krishi Vishwa Vidyalaya, Jabalpur during *kharif* season 2009-2010. The fifteen pigeonpea genotypes of medium maturity group were obtained from Project Co-ordinator - Pigeonpea, Indian Institute of Pulses Research (ICAR), Kalyanpur, Kanpur, Uttar Pradesh. The experiment was laid out in "Randomized Block Design" with 15 - (14 + 1 check) treatments and 3 replications. Each individual plot was of the size 1.8m X 5.0m having 3 rows with Row x Plant spacing

of 0.60m x 0.20m. The crop was kept unprotected to realize the pest infestation.

Pod and Grain damage

Observations were taken on pods of 5 plants selected randomly from each plot at harvest. The pigeonpea pods were classified as damage caused by pod fly, *Melanagromyza obtusa* Malloch, plume moth, *Exelastis atomosa* Washingham, *gram* pod borer, *Helicoverpa armigera* Hub., pod bug, *Clavigralla gibbosa* Spinola, and physiological disorder on the basis of characteristic distinguishing symptoms. The yield obtained in each genotype computed separately and converted to Kg/ha.

The symptoms of the pod damage caused by pod fly could be distinguished by the presence of tiny pin head exit holes on the pod, while in case of grain damage, the size of the grains were reduced and galleries were formed on the grains as a result of feeding by the maggot. Pupae or pupal cases were also found embedded with damaged grains (Singh and Van Emerden, 1979).

The damage due to gram pod borer could be distinguished by the presence of large sized holes on the pods. The grains were partially or wholly eaten by the larvae (Saxena, 1981).

The damage due to plume moth could be distinguished by the presence of tiny irregular holes on the pods and size of the holes was smaller than that caused by gram pod borer. The damaged grains were covered with fungal growth on the larval faecal deposition (Ayyar, 1940).

The damage due to pod bug could be distinguished by the twisting of pods and imparting a sickly appearance with shrivelled grains, followed by reduction in the grain size that can be crushed to powder when gently pressed between finger tips. While the symptoms due to physiological disorder can be distinguished by the underdeveloped pods along with shriveled grains accompanied by reduction in grain size that cannot be crushed to powder easily when pressed between finger tips (Das, 1990).

Percent pod and grain damage was worked out by following formula.

$$\text{Per cent pod or grain damage} = \frac{\text{Number of pods or grains damaged by a particular insect}}{\text{Total number of pods or grains examined}} \times 100$$

For assessment of reaction of genotypes to pod pest infestation and physiological disorder method advocated by (Landge, 2009) was used. Pigeonpea genotypes were categorized on the basis of observed relative pest infestation in categories namely least susceptible, susceptible, moderately susceptible and highly susceptible. For working out these susceptibility groups, grain damage caused by a particular pest and physiological disorder of all the 15 genotypes were arranged in an ascending manner and cumulative grain damage was worked out which was equally divided into 4 groups (if average is x per cent grain damage), least susceptible (ranged from 0% grain damage to x% grain damage), susceptible (> x% to 2x% grain damage), moderately susceptible (> 2x% to 3x% grain damage) and highly susceptible (>3x% to 4x% grain damage) respectively.

Statistical analysis

Data recorded on pod and grain damage was analyzed by the techniques of analysis of variance of (Panse and Sukhatme, 1967)

RESULTS AND DISCUSSION

The fifteen medium maturity group pigeon pea genotypes namely BDN-2001-6, BSMR-853, SKNP-207, SKNP-224, WRG-97, WRG-114, WRG-119, Guliyal red, 'Khargone-2' (Check), C-11, BSMR-893, BDN-2, JA-4, ICPL-84060 and ICPL-87089 were raised for studying the per cent pod and grain damage assessment by pod pest complex and physiological disorder.

Extent of damage caused by pod pest complex

Pod fly (*M. obtusa* Malloch)

In the present study the fifteen genotypes screened no genotype was found to be free from pod fly infestation.This finding is in accordance with the findings of (Srivastava and Mohapatra, 2002) they were screened fifteen medium maturing pigeonpea genotypes against pod borer complex and pod fly and reported that none of the genotypes were found to be resistant or tolerant to pod fly. Here the pod and grain damage significantly ranges from (2.11 to 8.79%) and (0.65% to 2.63%) respectively. Lowest grain damage was recorded in the genotype Khargone-2 (0.65%), followed by ICPL-84060 (0.79%), ICPL-87089 (0.95%), WRG-97 (1.03%) but they were at par with each other. Further, non-significant differences were observed between genotypes JA-4 (2.39%) and BSMR-853 (2.63%) in which highest grain damage was recorded. On cumulative grain damage (0.65% to 1.14%) five genotypes were seen to be least susceptible *viz*., Khargone-2, ICPL-84060, ICPL-87089, WRG-97 and BDN-2001-6. Recently (Kumar *et al*., 2015) screened eighteen pigeonpea long duration genotypes against pod fly and advocated that pod fly is the major pest infesting pigeonpea. Highest per cent pod and grain damage revealed in genotype IPA 7-10 (45% and 20.96%) lowest in genotype KA 12-2 (21.33% and 10.07%).

Plume moth (*E. atomosa* Washingham)

All the genotypes studied were prone to plume moth infestation pod and grain damage significantly ranged from (3.63% to 7.78%) and (1.12% to 2.56%) respectively. It was observed that lowest grain damage with non significant difference was recorded in the genotypes C-11 (1.12%), followed by Guliyal red (1.37%), Khargone-2 (1.39%), BSMR-893 (1.40%), WRG-119 (1.41%), SKNP-207 (1.42%), BSMR-853 (1.43%), WRG-97 (1.43%) and BDN-2001-6 (1.45%).Highest grain damage with non-significant differences was observed between genotypes ICPL-84060 (2.15%), ICPL-87089 (2.23%), WRG-114 (2.23%) and JA-4 (2.56%) respectively.This findings in accordance with the (Mali and Patil, 1994) findings they studied the reaction of nine pigeonpea genotypes against pod borer complex *viz*.,*H. armigera, M. testulalis, E. atomosa and M. obtusa* and reported that Variety T-21 was the only cultivar which was found to be least preferred by the pod borer complex. Incidence of lepidopterous pod borer including plume moth on long duration pigeonpea genotypes (MA-20, MAL-13, Bahar, MAL-24 and MA-3) studied by Jaisal *et al*. (2010) at Varanasi, Uttar Pradesh they reported pod damage by these pests was greatest on MAL-6 (14.1%). During the investigation four genotypes were found to be least susceptible

Table 1: Performance of pigeonpea genotypes against pod infesting insect pest complex and physiological disorder during *kharif* 2009-10

Sr. No.	Per cent damage by- Genotypes	Pod fly Pod	Pod fly Grain	Pigeonpea plume moth Pod	Pigeonpea plume moth Grain	Pod borer Pod	Pod borer Grain	Pod bug Pod	Pod bug Grain	Physiological disorder Pod	Physiological disorder Grain	Grain yield (kg/ha)
1	BDN-2001-6	3.66(10.99)	1.14(6.02)	6.97(15.21)	1.45(6.79)	2.42(8.79)	1.23H(6.20)	2.42(8.88)	0.97(5.55)	6.97(15.21)	2.61(9.14)	2732.16 H
2	BSMR-853	8.18(16.54)	2.63H(9.28)	3.63L(10.94)	1.43(6.80)	3.63H(10.94)	1.19(6.02)	11.81H(20.09)	3.82H(11.24)	8.18H(16.54)	2.63(9.28)	649.07
3	SKNP-207	4.54(12.25)	1.17(6.02)	4.54(12.25)	1.41(6.80)	1.81(7.71)	0.70(4.80)	2.72(9.46)	0.70(4.80)	3.63(10.94)	1.41(6.80)	1252.69
4	SKNP-224	4.24(11.81)	1.30(6.47)	5.45(13.41)	1.78(7.49)	1.20(6.20)	0.54(4.18)	3.33(10.20)	1.65(7.21)	2.11L(8.29)	1.24(6.23)	1489.42
5	WRG-97	3.93(11.38)	1.03(5.76)	3.93(11.38)	1.43(6.80)	1.81(7.71)	0.47(3.91)	3.93(11.15)	1.80(7.31)	4.24(11.77)	0.94L(5.56)	1609.46
6	WRG-114	4.84(12.56)	1.53(7.04)	7.27(15.55)	2.23(8.42)	2.11(8.29)	0.46(3.89)	3.63(10.79)	1.38(6.61)	3.63(10.88)	1.08(5.81)	2128.10
7	WRG-119	4.54(12.21)	1.79(7.43)	5.45(13.41)	1.41(6.72)	1.20(6.20)	0.34L(3.33)	4.84(12.65)	1.57(7.00)	5.15(12.97)	1.41(6.54)	1650.78
8	Guliyal red	5.75(13.75)	1.70(7.40)	4.24(11.77)	1.37(6.53)	0.90L(5.44)	0.64(4.56)	3.63(10.79)	1.37(6.42)	3.93(11.28)	1.77(7.36)	554.76 L
9	Khargone-2 (Check)	2.11L(8.29)	0.65L(4.55)	4.84(12.65)	1.39(6.63)	1.81(7.71)	0.73(4.90)	3.63(10.79)	1.31(6.49)	3.02(9.95)	0.98(5.62)	2093.88
10	C-11	5.45(13.31)	1.45(6.81)	6.36(14.51)	1.12L(5.96)	2.11(8.29)	0.97(5.59)	2.72(9.37)	1.44(6.70)	4.54(12.21)	2.38(8.84)	1942.33
11	BSMR-893	3.63(10.94)	1.40(6.80)	4.54(12.25)	1.40(6.80)	1.81(7.71)	0.70(4.80)	0.90L(5.44)	0.46L(3.89)	3.63(10.94)	1.17(6.02)	1414.44
12	BDN-2	5.45(13.41)	1.28(6.41)	5.45(13.35)	1.69(7.31)	2.11(8.29)	0.72(4.88)	4.24(11.77)	1.20(6.09)	6.06(14.17)	3.23H(10.31)	1943.76
13	JA-4	8.79H(17.15)	2.39(8.73)	7.88H(16.21)	2.56H(9.08)	3.33(10.45)	1.02(5.70)	7.27(15.47)	1.36(6.57)	5.45(13.41)	1.82(7.64)	1435.56
14	ICPL-84060	2.42(8.88)	0.79(5.05)	6.36(14.54)	2.15(8.39)	2.11(8.29)	0.79(4.94)	3.63(10.88)	1.35(6.63)	5.45(13.34)	1.67(7.38)	1960.68
15	ICPL-87089	3.02(9.95)	0.95(5.56)	6.66(14.84)	2.23(8.46)	2.11(8.29)	0.87(5.33)	4.54(11.90)	1.72(7.30)	6.06(14.08)	1.81(7.61)	2259.12
	Mean	4.70(12.23)	1.41(6.02)	5.57(13.48)	1.67(7.26)	2.03(8.02)	0.76(4.87)	4.22(11.31)	1.47(6.65)	4.80(12.40)	1.74(7.34)	1674.41
	SEm±	0.65	0.50	0.53	0.38	0.54	0.37	1.18	0.79	0.79	0.67	154.88
	CD at 5%	1.87	1.45	1.54	1.10	1.58	1.06	3.43	2.28	2.29	1.94	449.03

Figures in parentheses are arcsin transformed values; H = Highest L = Lowest

viz., C-11, Guliyal red, Khargone-2 and BSMR-893, and respective grain damage ranged from(1.12% to 1.40%).

Gram pod borer (*H. armigera* Hub.)

The pod and grain damage ranged significantly from (0.90% to 3.63%) and (0.34% to 1.23%) respectively. Lowest grain damage was recorded in the genotype WRG-119 (0.34%), followed by WRG-114 (0.46%), WRG-97 (0.47%), SKNP-224 (0.54%), Guliyal red (0.64%), SKNP-207 (0.70%), BSMR-893 (0.70%), BDN-2 (0.72%), Khargone-2 (0.73%), ICPL-84060 (0.79%), ICPL-87089 (0.87%), C-11 (0.97%), JA-4 (1.02%), BSMR-853 (1.19%), while highest grain damage (1.23%) was recorded in the genotype BDN-2001-6. However, genotypes WRG-119, WRG-114, WRG-97 and SKNP-224 were at par with each other. Further, non significant differences were observed between genotypes ICPL-87089, C-11, JA-4, BSMR-853 and BDN-2001-6 respectively. (Durairaj and Shanower, 2003) screened eight short duration pigeonpea genotypes against pod borer complex. Genotypes ICPL-151, ICPL-86012 and ICPL-88034 recorded minimum damage by pod borer and pod fly, and higher grain yields than the other genotypes, including the checks UPAS-120 and ICPL-87.In the present findings on the contrary genotypes *viz.,* ICPL-84060, ICPL-87089 and C-11 were moderately infested by gram pod borer. Further (Mandal, 2005) studied resistance to pod borers, *i.e. Maruca testulalis* [*M. vitrata*] and *H. armigera* reported that genotypes ICPL-306 and ICPL-850046 were resistant to pod

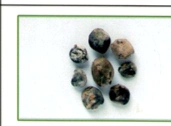
Pod	Particular	Grain
 Tiny pin head exit holes on pod	Pod fly	 Galleries on grain pupae
 Large sized holes on pod	Gam pod borer	 Partially eaten grains
 Tiny irregular holes on pod	Plume moth	 Fungal growth on grains
 Twisted sickle pods	Pod bug	 Shrivelled grains
 Under developed pods	Physiological disorder	 Reduced grain size

Plate 1: Damaging symptoms by pod infesting pests and physiological disorder

Table 2: Susceptibility groups of pigeonpea genotypes on the basis of per cent grain damage

Range of per cent damaged grains	Cumulative grain damage	Degree of susceptibility	No. of Entries	Genotypes
Pod fly *M. obtusa* Malloch				
0.65 to 1.14	< 5.3%	Least susceptible	5	Khargone-2, ICPL-84060, ICPL-87089, WRG-97, BDN-2001-6
1.17 to 1.40	> 5.3 to < 10.6%	Susceptible	4	SKNP-207, BDN-2, SKNP-224, BSMR-893
1.45 to 1.70	> 10.6% to < 15.9%	Moderately Susceptible	3	C-11, WRG-114, Guliyal red
1.79 to 2.63	> 15.9%	Highly susceptible	3	WRG-119, JA-4, BSMR-853
Plume moth *E. atomosa* Walsingham				
1.12 to 1.40	< 6.26%	Least susceptible	4	C-11, Guliyal red, Khargone-2, BSMR-893
1.41 to 1.45	> 6.26 to < 12.52%	Susceptible	5	WRG-119, SKNP-207, BSMR-853, WRG-97, BDN-2001-6
1.69 to 2.15	> 12.52% to < 18.78%	Moderately Susceptible	3	BDN-2, SKNP-224, ICPL-84060
2.23 to 2.56	> 18.78%	Highly susceptible	3	ICPL-87089, WRG-114, JA-4
Gram pod borer *H. armigera* Hub.				
0.34 to 0.64	< 2.84%	Least susceptible	5	WRG-119, WRG-114, WRG-97,SKNP-224, Guliyal red
0.70 to 0.73	> 2.84 to < 5.68%	Susceptible	4	SKNP-207, BSMR-893, BDN-2, Khargone-2
0.79 to 0.97	> 5.68% to < 8.52%	Moderately susceptible	3	ICPL-84060, ICPL-87089,C-11
1.02 to 1.23	> 8.52%	Highly susceptible	3	JA-4, BSMR-853, BDN-2001-6
Pod bug *C. gibbosa* Spinola				
0.46 to 1.31	< 5.52%	Least susceptible	5	BSMR-893, SKNP-207, BDN-2001-6, BDN-2, Khargone-2
1.35 to 1.38	> 5.52 to < 11.04%	Susceptible	4	ICPL-84060, JA-4, Guliyal red, WRG-114
1.44 to 1.72	> 11.04% to < 16.56%	Moderately susceptible	4	C-11, WRG-119, SKNP-224, ICPL-87089,
1.80 to 3.82	> 16.56%	Highly susceptible	2	WRG-97, BSMR-853
Physiological disorder				
0.94 to 1.24	< 6.53%	Least susceptible	5	WRG-97, Khargone-2, WRG-114, BSMR-893, SKNP-224
1.41 to 1.77	> 6.53 to < 13.06%	Susceptible	4	SKNP-207, WRG-119, ICPL-84060, Guliyal red
1.81 to 2.38	> 13.06% to < 19.59%	Moderately susceptible	3	ICPL-87089, JA-4, C-11
2.61 to 3.23	> 19.59%	Highly susceptible	3	BDN-2001-6, BSMR-853, BDN-2

borers and registered 5.1% and 10% pod damage respectively. On the other hand pigeonpea genotypes studied in given experiment reveled that five genotypes *viz.,* WRG-119, WRG-114, WRG-97, SKNP-224 and Guliyal red least susceptible to *H. armigera* with grain damage ranged from (0.34% to 0.64%).

Pod bug (*C. gibbosa* Spinola)

The pod bug adults and nymphs considerably damaged pods and grains it ranged from (0.90% to 11.81%) and (0.46% to 3.82%) respectively. Pod damage was found to be more than the grain damage. The present findings confirm the findings of (Singh and Singh, 1990). They also recorded more damage to pods in comparison to seeds. Lowest grain damage was recorded in the genotype BSMR-893 (0.46%) followed by SKNP-207 (0.70%), BDN-2001-6 (0.97%), BDN-2 (1.20%), Khargone-2 (1.31%), ICPL-84060 (1.35%), JA-4 (1.36%), Guliyal red (1.37%), WRG-114 (1.38%), C-11 (1.44%), WRG-119 (1.57%), SKNP-224 (1.65%), ICPL-87089 (1.72%), WRG-97 (1.80%), while highest grain damage (3.82%) was recorded in the genotype BSMR-853. However, genotypes BSMR-893, SKNP-207, BDN-2001-6 and BDN-2 were at par with each other. (Singh *et al.,* 2005) screened fifteen early maturing pigeonpea genotypes for their resistance to pod bug, *C. gibbosa,* results revealed that ICPL-87, ICPL-86012 and ICPL-84052 were the least preferred genotypes, whereas ICPL-84023 was highly preferred by the pod bug. Genotypes studies under *viz.*, ICPL-87089 and ICPL-84060 also confirms these findings they were found moderately susceptible and susceptible respectively to pod bug infestation. Screening work carried out by (Khan *et al.,* 2014) reveled that genotypes ICP 10531, ICP13212, ICPL 20036, ICPHaRL 4985-1 were found to be most susceptible while genotype ICP 10531 was more susceptible with pod damage of (21.5%) when compared to local check, 'Bahar'. Similar findings also got during the present study *i.e.* genotypes khargone-2 check, least infested by pod bug.

Extent of damage caused by physiological disorder

Out of 15 pigeonpea genotypes under observation, no genotype was found to be free from damage due to physiological disorder.The pod and grain damage significantly ranged from (2.11% to 8.18%) and (0.94% to 3.23%) respectively. Lowest grain damage was recorded in the genotype WRG-97 (0.94%) while highest grain damage was recorded in the genotype BDN-2 (3.23%). Nineteen Indo-African pigeonpea derivatives of medium maturing group assessed by (Veda *et al.*, 2009) the relative susceptibility recorded against physiological disorder, entry ICP-11488 X KPL-43-3 had minimum grain damage. Present study revealed that among the fifteen genotypes screened five genotypes *viz.,* WRG-97, Khargone-2, WRG-114, BSMR-893 and SKNP-224 found least susceptible against physiological disorder.

In general the average grain infestation caused by the four insect pest species it is apparent that damage caused by plume moth 1.67% was relatively highest It decipher plume moth as the most important pest of pigeonpea followed by pod bug 1.47%, pod fly 1.41% and gram pod borer 0.76% respectively. Whereas grain damaged due to physiological disorder was 1.74% which exceeds the damage caused by any insect individually. Further on grain damage basis genotype Khargone-2 was found to be least susceptible against two insect pest *viz.,* pod fly (0.65%) and plume moth (1.39%) and physiological disorder (0.98%) respectively. Besides genotype WRG-97 against pod fly (1.03%) and pod borer (0.47%) also against physiological disorder (0.94%) so, it may be concluded that these genotypes are most resistant to above specified pests and physiological disorder and can be incorporate in management of infestation prevalent areas.

Yield

Perusal of the data on grain yield in the context of pod pest complex and physiological disorder revealed significant differences between the genotypes. Maximum grain yield (2732.16 kg/ha) was recorded in BDN-2001-6 which was significantly superior to the rest of the genotypes and over check 'Khargone-2' confirms its higher degree of tolerance.

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