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SEED AS PROTECTANT AGAINST *CALLOSOBRUCHUS MACULATUS* ON GREENGRAM.

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ABSTRACT

When 10 plant oils were tested at 0.02, 0.05 and 0.1 per cent against the pulse beetle for their bio-activity, it was observed that neem oil at all the three doses reduced egg hatching, adult emergence and seed weight loss. All oils were effective at 0.1 per cent concentration. At 0.5 and 1.0 per cent, the development of the beetle was greatly affected as evident from no adult emergence and complete protection of seed was achieved. Further, the oil treatments did not affect the germination of the greengram seeds.

KEY WORDS: *Callosobruchus maculatus*, Greengram, Vegetable oils.

The pulse beetle, *Callosobruchus maculatus* (F.) (Bruchidae : Coleoptera) is one of the major pests of pulses in storage. The female oviposits on the grains. The newly hatched larva enters the grain and feeds by remaining inside. This behaviour can be well utilised in managing the pest by safe and feasible approach by smearing the seeds with oils without causing any ill effects on the viability of the seeds.

MATERIALS AND METHODS

Oils of coconut, mustard, gingelly, groundnut, sunflower, oil palm, castor, palmarosa, neem and jatropa were tested at 0.02%, 0.05% and 0.1% concentrations. For fixing these concentrations, a pilot experiment was conducted at 0.5 and 1.0 per cent levels which revealed that both of them were too high concentrations since no adult emergence was observed in all the treatments though certain eggs were laid.

The greengram seeds used were heat sterilised at 60°C for 30 min in a hot air oven and cooled to room temperature to destroy any insect developed inside the seeds.

Two hundred g of heat sterilized greengram seeds were coated with the required concentration of oil and kept as stock material. The experiments were conducted at four intervals viz., 0, 1, 2 and 3 months after treatment (MAT) by drawing 10 g of seeds from the stock material. For each treatment, three pairs of freshly emerged adults were introduced and three replications were maintained.

Ten days after inoculation (DAI) of the beetles, the number of eggs hatched, at 25 DAI number of adults emerged and at 45 DAI the weight loss in the seeds were assessed. For germination test, paper roll towel method was followed and on the 10th day, the germination percentage was worked out.

RESULTS AND DISCUSSION

Egg hatching

Neem oil registered low egg hatching (69.92 no.) followed by jatropha oil (79.67) and palmarosa oil (79.72) which were on par and significantly lower than control (185.92). Seeds treated with sunflower oil registered maximum number of eggs hatched (148.64). With regard to the concentrations, the number of eggs hatched was minimum (87.88) at 0.1 per cent (Table 1). The treatment with neem oil was found to be effective at 0.02, 0.05 and 0.1 per cent levels.

Adult emergence

The number of adults emerged was minimum (66.75) in neem oil followed by palmarosa oil (75.86) and jatropha oil (76.06), while control registered the maximum number of adults (178.25) emerged. Comparison of concentrations revealed that in all the treatments 0.1 per cent caused significantly lower adult emergence. The mean number of adults emerged was 84.23 (Table 2).

Seed weight loss

Data on the per cent weight loss (Table 3) showed that it was minimum in neem oil (22.51)

Table 1. Number of eggs hatched (*Callosobruchus maculatus*) on greengram seeds coated with different oils at three concentrations

Treatment	Month(s) after treatment				Mean	Concentration (%)		
	0	1	2	3		0.02	0.05	0.1
Coconut oil	82.44 (9.00)$^{d}_{A}$	85.11 (9.18)$^{bcd}_{A}$	107.22 (10.30)$^{bcd}_{B}$	133.89 (11.53)$^{d}_{C}$	102.17 (10.00)^{d}	119.08 (10.87)$^{ef}_{C}$	103.17 (10.07)$^{cd}_{B}$	84.25 (9.07)$^{de}_{A}$
Mustard oil	67.22 (8.11)$^{bc}_{A}$	81.33 (8.97)$^{bcd}_{B}$	100.89 (10.01)$^{bc}_{C}$	123.44 (11.08)$^{cd}_{D}$	93.22 (9.54)^{c}	105.58 (10.20)$^{bcde}_{B}$	97.33 (9.80)$^{c}_{B}$	76.75 (8.63)$^{bcd}_{A}$
Gingelly oil	65.78 (8.08)$^{bc}_{A}$	86.22 (9.27)$^{cd}_{B}$	100.89 (10.00)$^{b}_{C}$	112.44 (10.57)$^{bc}_{C}$	91.33 (9.48)$^{c}_{A}$	103.58 (10.12)$^{bcd}_{B}$	90.08 (9.43)$^{bc}_{A}$	80.33 (8.90)$^{cd}_{A}$
Groundnut oil	74.11 (8.57)$^{cd}_{A}$	91.89 (9.54)$^{d}_{B}$	123.78 (11.09)$^{de}_{C}$	168.56 (12.97)$^{e}_{D}$	114.58 (10.54)^{e}	127.83 (11.19)$^{f}_{B}$	117.00 (10.68)$^{de}_{B}$	98.92 (9.76)$^{cd}_{A}$
Sunflower oil	104.11 (10.16)$^{e}_{A}$	124.56 (11.12)$^{e}_{B}$	170.33 (13.01)$^{f}_{C}$	195.56 (13.97)$^{fg}_{D}$	148.64 (12.07)^{g}	169.25 (12.92)$^{h}_{C}$	148.58 (12.09)$^{f}_{B}$	128.08 (11.18)$^{ef}_{A}$
Palm oil	86.44 (9.27)$^{d}_{A}$	109.89 (10.45)$^{e}_{B}$	136.89 (11.64)$^{e}_{C}$	172.33 (13.11)$^{e}_{D}$	126.39 (11.12)^{f}	143.92 (11.90)$^{g}_{B}$	124.33 (11.02)$^{e}_{A}$	110.92 (10.42)$^{g}_{A}$
Castor oil	77.44 (8.70)$^{cd}_{A}$	117.33 (10.78)$^{e}_{B}$	122.33 (11.01)$^{de}_{B}$	181.00 (13.44)$^{ef}_{C}$	124.53 (10.98)^{f}	146.17 (12.01)$^{g}_{C}$	123.25 (10.97)$^{e}_{B}$	104.17 (9.97)$^{f}_{A}$
Palmarosa oil	54.00 (7.28)$^{ab}_{A}$	70.89 (8.33)$^{ab}_{B}$	96.78 (8.33)$^{a}_{B}$	97.22 (9.84)$^{ab}_{C}$	79.72 (8.81)^{b}	93.83 (9.64)$^{bc}_{B}$	75.58 (8.63)$^{a}_{A}$	69.75 (8.17)$^{abc}_{A}$
Neem oil	48.78 (6.97)$^{a}_{A}$	66.33 (8.09)$^{a}_{B}$	74.33 (8.09)$^{a}_{B}$	90.22 (9.47)$^{a}_{C}$	69.92 (8.27)^{a}	83.17 (9.04)$^{a}_{C}$	67.25 (8.14)$^{a}_{A}$	59.33 (7.63)$^{a}_{A}$
Jatropha oil	50.67 (7.07)$^{a}_{A}$	74.44 (8.55)$^{abc}_{B}$	86.56 (8.55)$^{a}_{B}$	107.00 (10.32)$^{abc}_{C}$	79.67 (8.80)^{b}	91.92 (9.49)$^{ab}_{B}$	80.75 (8.89)$^{ab}_{B}$	66.33 (8.02)$^{ab}_{A}$
Control	131.33 (11.45)$^{e}_{A}$	165.00 (12.82)$^{f}_{A}$	213.33 (14.60)$^{g}_{B}$	234.00 (15.29)$^{g}_{B}$	185.92 (13.54)^{h}			
Mean	73.04 (8.42)^{a}	93.19 (9.54)^{b}	115.27 (10.60)^{c}	141.26 (11.75)^{d}	-	118.43 (10.74)^{c}	102.73 (9.97)^{b}	87.88 (9.18)^{a}
Concentration (%)								
0.02	85.00 (9.13)$^{c}_{A}$	108.20 (10.33)$^{c}_{B}$	131.57 (11.38)$^{c}_{C}$	148.97 (12.10)$^{c}_{D}$				
0.05	72.40 (8.43)$^{b}_{A}$	89.50 (9.40)$^{b}_{B}$	109.43 (10.36)$^{b}_{C}$	139.60 (11.70)$^{b}_{D}$				
0.1	55.90 (7.40)$^{a}_{A}$	74.70 (8.55)$^{a}_{B}$	95.00 (9.66)$^{a}_{C}$	125.93 (11.10)$^{a}_{D}$				

Mean of three replications ; Figures in parentheses are square root transformed values. In a column/row means followed by the same small/capital letter(s) respectively are not significantly different by DMRT (P = 0.05).

followed by palmarosa oil (23.64) which were on par and significantly different from control (44.87). Among the concentrations, seeds treated with 0.1 per cent oil had minimum weight loss (25.41%) and significantly different from the other two concentrations. neem oil was effective at all the three concentrations tested.

Germination

The germination was not affected due to the treatments (Table 4). The germination ranged from 87.92 to 90.97 per cent in the treatments and they were on par with control (90%).

The effectiveness of oils was earlier reported by Choudhary (1992), Shukla *et al.*, (1992), Khatra *et al.*, (1993) and Lakhanpal *et al.*, (1995). and dose dependent by Choudhary, 1992. The effectiveness of the essential oil *viz.*, clove oil as an insecticide was reported by Gunathilagaraj and Kumaraswami (1978) which resulted in complete mortality of the adults within 24 h. The mode of action of oils is

Table 2. Number of adult *Callosobruchus maculatus* emerged from greengram seeds coated with oils at three concentrations.

Treatment	Month(s) after treatment				Mean	Concentration (%)		
	0	1	2	3		0.02	0.05	0.1
Coconut oil	78.56 $(8.78)^{d}_{A}$	81.56 $(8.99)^{cd}_{A}$	103.56 $(10.12)^{cd}_{B}$	129.56 $(11.35)^{d}_{C}$	98.31 $(9.81)^{d}$	114.25 $(10.64)^{cd}_{C}$	99.75 $(9.90)^{cd}_{B}$	80.92 $(8.89)^{dc}_{A}$
Mustard oil	63.11 $(7.86)^{bc}_{A}$	78.11 $(8.78)^{bcd}_{B}$	97.00 $(9.82)^{bc}_{C}$	120.00 $(10.93)^{cd}_{D}$	89.56 $(9.35)^{c}$	101.42 $(9.99)^{bc}_{B}$	93.83 $(9.62)^{c}_{B}$	73.42 $(8.43)^{bcd}_{A}$
Gingelly oil	61.56 $(7.82)^{bc}_{A}$	81.78 $(9.03)^{cd}_{B}$	96.33 $(9.78)^{bc}_{BC}$	108.33 $(10.38)^{bc}_{C}$	87.00 $(9.25)^{c}$	98.58 $(9.86)^{b}_{B}$	85.67 $(9.19)^{bc}_{A}$	76.75 $(8.70)^{cd}_{A}$
Groundnut oil	70.56 $(8.36)^{cd}_{A}$	88.11 $(9.34)^{d}_{B}$	119.89 $(10.91)^{de}_{C}$	163.67 $(12.78)^{e}_{D}$	110.56 $(10.35)^{e}$	123.42 $(10.99)^{d}_{B}$	112.92 $(10.48)^{de}_{B}$	95.33 $(10.97)^{ef}_{A}$
Sunflower oil	100.00 $(9.95)^{e}_{A}$	118.89 $(10.86)^{ef}_{B}$	166.22 $(12.85)^{f}_{C}$	189.11 $(13.74)^{fg}_{D}$	143.56 $(11.85)^{g}$	163.33 $(12.69)^{f}_{C}$	143.83 $(11.89)^{f}_{B}$	123.50 $(10.97)^{g}_{A}$
Palm oil	82.56 $(9.06)^{d}_{A}$	106.11 $(10.26)^{e}_{B}$	132.11 $(11.42)^{e}_{C}$	167.14 $(12.93)^{e}_{D}$	122.06 $(10.92)^{f}$	139.67 $(11.72)^{e}_{B}$	120.25 $(10.84)^{e}_{A}$	106.25 $(10.19)^{f}_{A}$
Castor oil	73.67 $(8.48)^{cd}_{A}$	112.78 $(10.56)^{e}_{B}$	118.22 $(10.82)^{de}_{B}$	176.22 $(13.27)^{ef}_{C}$	120.22 $(10.78)^{f}$	140.92 $(11,79)^{e}_{C}$	119.50 $(10.79)^{e}_{B}$	100.25 $(9.77)^{f}_{A}$
Palmarosa oil	51.33 $(7.10)^{ab}_{A}$	67.44 $(8.11)^{ab}_{B}$	92.33 $(9.58)^{bc}_{C}$	92.33 $(9.59)^{ab}_{C}$	75.86 $(8.59)^{b}$	89.33 $(9.40)^{b}_{B}$	72.00 $(8.42)^{a}_{A}$	66.25 $(7.96)^{abc}_{A}$
Neem oil	46.44 $(6.80)^{a}_{A}$	63.22 $(7.90)^{a}_{B}$	71.11 $(8.35)^{a}_{B}$	86.22 $(9.26)^{a}_{C}$	66.75 $(8.08)^{a}$	79.92 $(8.86)^{a}_{C}$	63.83 $(7.93)^{a}_{A}$	56.50 $(7.43)^{a}_{A}$
Jatropha oil	47.78 $(6.89)^{a}_{A}$	71.78 $(8.39)^{abc}_{B}$	82.78 $(9.04)^{ab}_{BC}$	101.89 $(10.07)^{ab}_{C}$	76.06 $(8.59)^{b}$	88.17 $(9.29)^{ab}_{C}$	76.92 $(8.67)^{ab}_{B}$	63.08 $(7.82)^{ab}_{A}$
Control	127.00 $(11.26)^{f}_{A}$	147.67 $(12.14)^{f}_{A}$	209.67 $(14.47)^{g}_{B}$	228.67 $(15.11)^{g}_{B}$	178.25 $(13.25)^{h}$			
Mean	69.47 $(8.21)^{a}$	88.94 $(9.32)^{b}$	111.24 $(10.40)^{c}$	136.55 $(11.55)^{d}$	-	113.90 $(10.52)^{c}$	98.95 $(9.77)^{b}$	84.23 $(8.90)^{a}$
Concentration (%)								
0.02	80.40 $(8.88)^{c}_{A}$	10.072 $(10.14)^{c}_{B}$	127.50 $(11.20)^{c}_{C}$	143.63 $(11.88)^{b}_{D}$				
0.05	69.13 $(8.24)^{b}_{A}$	85.90 $(9.20)^{b}_{B}$	91.07 $(10.15)^{b}_{C}$	135.07 $(11.30)^{b}_{D}$				
0.1	20.37 $(7.21)^{a}_{A}$	22.95 $(8.33)^{a}_{B}$	26.22 $(9.45)^{a}_{C}$	32.11 $(10.91)^{a}_{d}$				

Mean of three replications ; In a column/row means followed by the same small / capital letter(s) respectively are not significantly different by DMRT (P=0.05).

partially attributed to interference in normal respiration, resulting in suffocation (Hewlett, 1975; Schoonhoven, 1978). Repellent and ovicidal action of different oils have also been reported (Varma and Pandey, 1978 ; Babu *et al.*, 1989). Egg mortality has been attributed to toxic compounds (Su *et al.*1972) and also to the physical properties which cause changes in surface tension and oxygen tension within the egg. In oil treatment, the oil entered through the micropile of the eggs and killed the developing larvae and thus reduced the emergence of progency from the egg (Singh *et al.*,1978). In the present study oviposition was greatly reduced in seed treatment with higher doses of oil than at lower doses, mainly due to the impairment of respiratory activity due to physical effects. Similar results have been reported in mustard oil (Singal and Singh, 1990), groundnut oil (Uvah and Ishaya, 1992) and on various oils by Pandey and Varma (1979), Sujatha and Ponnaiah (1985) and Don-Pedro (1989). Gunathilagaraj and Kumaraswami (1977) reported that the oils of coconut, gingelly, groundnut and castor were effective in preventing the development and

Table 3. Weight-loss of greengram seeds coated with different oils at three concentration due to development of *Callosobruchus maculatus*

Treatment	Month(s) after treatment					Concentration (%)		
	0	1	2	3	Mean	0.02	0.05	0.1
Coconut oil	24.09^{d}_{A}	24.34^{a}_{A}	28.48^{bc}_{B}	33.26^{d}_{C}	27.54^{de}	30.68^{d}_{C}	27.75^{d}_{B}	24.20^{d}_{A}
Mustard oil	21.57^{abcd}_{A}	23.83^{a}_{A}	27.19^{b}_{B}	31.80^{cd}_{C}	26.10^{cd}	28.62^{c}_{C}	26.08^{cd}_{B}	23.60^{bcd}_{A}
Gingelly oil	21.61^{abcd}_{A}	24.54^{a}_{AB}	26.88^{ab}_{BC}	29.00^{bc}_{C}	25.51^{bc}	27.38^{bc}_{B}	25.18^{bc}_{A}	23.96^{cd}_{A}
Groundnutoil	23.58^{bcd}_{A}	25.66^{ab}_{A}	31.74^{cd}_{B}	40.62^{e}_{C}	30.40^{ef}	32.78^{e}_{C}	30.61^{e}_{B}	27.81^{e}_{A}
Sunflower oil	27.89^{e}_{A}	31.28^{e}_{B}	41.09^{e}_{C}	45.58^{f}_{D}	36.46^{h}	40.49^{g}_{C}	36.30^{f}_{C}	32.58^{f}_{A}
Palm oil	24.72^{de}_{A}	28.71^{bc}_{B}	33.84^{d}_{C}	41.57^{e}_{D}	32.21^{g}	35.78^{f}_{C}	31.76^{e}_{B}	29.10^{e}_{A}
Castor oil	23.11^{bcd}_{A}	30.19^{e}_{B}	31.06^{cd}_{B}	43.17^{ef}_{C}	31.88^{fg}	36.19^{f}_{C}	31.39^{e}_{B}	28.06^{e}_{A}
Palmarosa oil	20.11^{abc}_{A}	22.60^{a}_{A}	25.89^{ab}_{B}	25.97^{ab}_{B}	23.64^{a}	25.78^{ab}_{B}	23.21^{a}_{A}	21.94^{ab}_{A}
Neem oil	19.41^{a}_{A}	22.10^{a}_{AB}	23.28^{a}_{B}	25.23^{a}_{B}	22.51^{a}	24.52^{a}_{B}	22.12^{a}_{A}	20.88^{a}_{A}
Jatropha oil	19.64^{ab}_{A}	23.21^{a}_{B}	25.12^{ab}_{BC}	27.88^{ab}_{C}	23.97^{ab}	25.95^{ab}_{C}	23.94^{ab}_{C}	22.00^{abc}_{A}
Control	32.40^{e}_{A}	38.17^{d}_{AB}	51.63^{f}_{BC}	57.27^{g}_{C}	44.87^{c}			
Mean	22.89^{a}	26.05^{b}	30.17^{c}	35.14^{d}	-	30.82^{c}	27.83^{b}	25.41^{a}
Concentration (%)								
0.02	24.80^{c}_{A}	28.72^{c}_{B}	33.23^{c}_{C}	36.52^{c}_{D}				
0.05	22.55^{b}_{A}	25.27^{b}_{B}	28.92^{b}_{C}	34.59^{b}_{D}				
0.1	20.37^{a}_{A}	22.95^{a}_{B}	26.22^{a}_{C}	32.11^{a}_{D}				

Mean of three replications ; In a column/row means followed by the same small/capital letter(s) respectively are not significantly different by DMRT (P=0.05).

multiplication of the beetle for four months. The efficacy of palmarosa and jatropha oils is reported for the first time against the pulse beetle.

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Table 4. Germination of greengram seeds at indicated month(s) after storage of seeds coated with different oils at three concentrations.

Treatment	Month(s) after treatment					Concentration (%)		
	0	1	2	3	Mean	0.02	0.05	0.1
Coconut oil	90.00 (71.79)$^{abc}_{AB}$	88.33 (70.09)$^{b}_{B}$	90.56 (72.28)$^{ab}_{AB}$	91.67 (73.37)$^{a}_{A}$	90.14 (71.88)^{ab}	90.00 (71.73)$^{ab}_{AB}$	88.75 (70.55)$^{abc}_{B}$	91.67 (73.37)$^{a}_{A}$
Mustard oil	91.67 (73.37)$^{ab}_{A}$	90.56 (72.28)$^{ab}_{A}$	91.67 (73.37)$^{ab}_{A}$	90.00 (71.79)$^{a}_{A}$	90.97 (72.70)^{a}	90.42 (72.09)$^{ab}_{A}$	90.83 (72.55)$^{ab}_{A}$	91.67 (73.47)$^{a}_{A}$
Gingelly oil	92.78 (74.60)$^{a}_{A}$	90.00 (71.79)$^{ab}_{AB}$	88.89 (70.70)$^{ab}_{B}$	90.56 (72.28)$^{a}_{AB}$	90.56 (72.34)^{a}	89.17 (70.91)$^{b}_{A}$	90.83 (72.65)$^{ab}_{A}$	91.67 (73.47)$^{a}_{A}$
Groundnut oil	88.33 (70.28)$^{bcde}_{A}$	90.56 (72.54)$^{ab}_{A}$	87.78 (69.80)$^{b}_{A}$	90.00 (71.79)$^{a}_{A}$	89.17 (71.10)^{abc}	85.42 (67.64)$^{c}_{B}$	90.83 (72.65)$^{ab}_{A}$	91.25 (73.01)$^{ab}_{A}$
Sunflower oil	86.11 (68.28)$^{de}_{B}$	91.67 (74.75)$^{a}_{A}$	89.44 (71.18)$^{ab}_{B}$	88.89 (70.70)$^{a}_{B}$	89.03 (71.15)^{abc}	88.33 (70.18)$^{bc}_{A}$	89.17 (71.05)$^{abc}_{A}$	89.58 (72.23)$^{abc}_{A}$
Palm oil	89.44 (71.18)$^{abcd}_{AB}$	90.57 (72.28)$^{ab}_{A}$	87.78 (69.99)$^{b}_{A}$	86.87 (68.70)$^{a}_{B}$	88.61 (70.54)^{abc}	87.08 (69.34)$^{bc}_{A}$	88.75 (70.55)$^{abc}_{A}$	90.00 (71.73)$^{abc}_{A}$
Castor oil	87.22 (69.18)$^{cde}_{A}$	86.67 (68.89)$^{b}_{A}$	88.89 (70.76)$^{ab}_{A}$	89.44 (71.18)$^{a}_{A}$	88.06 (70.01)^{c}	88.33 (70.23)$^{b}_{A}$	87.08 (69.19)$^{c}_{A}$	88.75 (70.59)$^{abc}_{A}$
Palmarosal oil	88.33 (70.28)$^{bcde}_{A}$	91.11 (73.21)$^{ab}_{A}$	90.00 (71.99)$^{ab}_{A}$	89.44 (71.18)$^{a}_{A}$	89.72 (71.67)^{abc}	89.58 (71.51)$^{ab}_{AB}$	91.67 (73.47)$^{a}_{A}$	87.92 (70.01)$^{bc}_{B}$
Neem oil	91.11 (73.02)$^{ab}_{A}$	89.44 (71.50)$^{ab}_{AB}$	92.22 (73.99)$^{a}_{A}$	87.78 (69.80)$^{a}_{B}$	90.14 (72.08)^{ab}	92.50 (74.39)$^{a}_{A}$	88.33 (70.33)$^{bc}_{B}$	89.58 (71.51)$^{abc}_{B}$
Jatropha oil	87.22 (69.18)$^{cde}_{B}$	90.56 (72.41)$^{ab}_{A}$	86.17 (68.22)$^{b}_{AB}$	87.78 (69.60)$^{a}_{AB}$	87.92 (69.85)^{c}	88.33 (70.18)$^{bc}_{A}$	87.08 (69.04)$^{c}_{A}$	88.33 (70.33)$^{bc}_{A}$
Control	85.00 (67.38)$^{e}_{B}$	91.67 (73.37)$^{ab}_{A}$	91.67 (73.37)$^{ab}_{A}$	91.67 (73.37)$^{a}_{A}$	90.00 (71.87)^{abc}			
Mean	89.09 (70.09)^{b}	90.00 (71.99)^{a}	89.41 (71.30)^{b}	89.30 (71.11)^{b}		88.92 (70.82)^{b}	89.33 (1.20)^{ab}	90.04 (71.97)^{a}
Concentration (%)								
0.02	89.00 (70.90)$^{a}_{AB}$	90.50 (72.36)$^{a}_{A}$	87.53 (69.84)$^{b}_{B}$	88.33 (70.18)$^{a}_{B}$				
0.05	89.00 (70.84)$^{a}_{A}$	89.50 (71.45)$^{a}_{A}$	88.83 (70.71)$^{ab}_{A}$	90.00 (71.81)$^{a}_{A}$				
0.1	89.67 (71.67)$^{a}_{AB}$	89.83 (72.02)$^{a}_{AB}$	91.33 (73.12)$^{a}_{A}$	89.33 (71.13)$^{a}_{B}$				

Mean of three replications : Figures in parentheses are arc sine values. In a column/row means followed by the same small/capital letter(s) are not significantly different by DMRT (P=0.05)

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