EVALUATION OF SOME EDIBLE OILS AS PROTECTANTS OF CHICKPEA SEEDS, *C. ARIETINUM* L. AGAINST PULSE BEETLE, *CALLOSOBRUCHUS CHINENSIS* (L.) BY PREFERENTIAL FEEDING METHOD

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The oils of mustard, rapeseed, *taramira*, groundnut, coconut, sesamum, sunflower, soybean and palm, at 2 and 4 ml/kg, were evaluated as protectants of *Cicer arietinum* against oviposition, development, seed damage and weight loss due to infestation of *C. chinensis* after different storage intervals. Beetles preferred untreated rather than treated seeds for egg laying 30 days and 90 days after treatment. After 150 days of treatment both were equally preferred. Irrespective of the oils, seeds treated 2 ml oil/kg were preferred more for egg laying than those of treated 4 ml/kg seed 30 days and 90 days of treatment, whereas 150 days after treatment, both the doses were equally preferred for egg laying. More development of beetle, and consequently more weight loss and seed damage, was recorded in untreated than treated seeds. Similarly, irrespective of these oils, the 2 ml/kg dose was less effective in reducing development, weight loss and seed damage than 4 ml/kg. At 2 ml/kg, only palm, rapeseed, groundnut, coconut and *taramira* oils inhibited development, weight loss and seed damage amost completely only after 30 days of oil treatment. While at 4 ml/kg dose-palm, mustard, rapeseed, *taramira*, groundnut and coconut oils provided almost complete protection after 30 days as well as 90 days of treatment. Whereas after 150 days of treatment none of the oil was able to provide complete protection at any dose.

INTRODUCTION

In India, pulses are an important source of proteins and other minerals in human diets. Of the several species of bruchids infesting pulses during storage, the pulse beetle, *C. chinensis* (L.) is the most important pest of chick-pea causing weight loss, lower germination potential and quality deterioration (**Mllkherjee** *et al.*, 1970 ; **Singal** and **Singh**, 1985 ; **Singal**, 1987). The use of improved storage structures is not possible because of their cost for low income group farmers at village level. Of the various chemical control methods, fumigation is the most effective but this method, because of high risk to human and animal health, again is not suitable in traditional living conditions in rural India. It is, therefore, imperative to look for alternative methods for cheap and safe storage of grains and seed material.

The use of edible oils as protectants of pulses when stored on small scale against various pulse beetles is /gaining momentum as these oils constituting a part of their normal diet are non-toxic to man and animals. The studies on efficacy and persistance of some edible oils earlier conducted by **Sheokand** *et al.* (1989) by forced feeding method needs further investigation so that cost of control may be minimized. Therefore, investigation on the evaluation of some edible plant oils as by preferential feeding, protectants of chickpea, *Cicer arietinum* L. against pulse beetle *C. chinensis* (L.) was carried at lower closes i.e. 2 ml and 4 ml/kg seed.

MATERIAL AND METHODS

Nine edible plant oils were evaluated at 2 and 4 ml/kg seed level, 30, 90 and 150 days after treatment. Oils used were palm (*Elaeis quineensis* Jacq.), mustard (*Brassica juncea* L., Czern and Cross), rapeseed (*B. compestris* L. Var. toria Duth), *taramira* (*Eruca sativa* Mill.), groundnut (*Arachis hypogaea* L.), coconut (*Cocos mucifera* L.), sesamum (*Sesamum indicum* L.), sunflower (*Helianthus annus* L.) and soybean (*Glycine max* L. Merrill). Calculated amount of each oil was added to the chickpea seed mixture in a round bottomed flask of 5 liter capacity. The flask was shaken vigorously to smear the oil uniformly over the seed. Treated seeds were stored for different periods before these were exposed to insect infestation by the preferential feeding method. For this, at a particular storage interval 10 g of seeds treated with each oil at each level or dose were placed in a plastic tube of size 5,5 x 4,5 cm. All these tubes containing seed were arranged randomly in a big tray without any lid. The tray was covered with veil cloth fastened with rubber band. Each treatment including the control was replicated 4 times. Thus, there were 76 tubes in the tray. Eight hundred pairs of 0 - 24 hours old adults of pulse beetle were released in the tray. For this, three holes were made in the veil cloth at uniform distance and after release of adults in the tray these holes were plugged, and tray was placed in incubator at a temperature of 30 $\pm$ 2°C. Beetles were removed after 7 days and number of eggs laid on the seeds was recorded treatment-wise. After counting the number of eggs, the seeds were again placed in the respective tubes. The tubes were covered with perforated lids and were kept undisturbed in the tray in the incubator till the emergence of F_1 adults started. The emerging adults were removed daily for 50 days i.e. till the completion of emergence to avoid further breeding. Thus, the number of F_1 adults emerged from each tube were recorded. The number of damaged and undamaged seeds was counted in each tube by recording the holes in the seeds. Then percentage of damaged seeds and per cent loss in weight were calculated by the method described by **Adams** and **Schulten** (1978).

Per cent weight loss = $\underline{(UNd) - (DNu)}$

U (Nd + Nu)

where U = weight of undamaged grains
Nu = number of undamaged grains
D = weight of damaged grains
Nd = number of damaged grains

$$\text{Per cent damaged seeds} = \frac{\text{Number of holed seeds in the tube}}{\text{Total number of seeds in the tube}} \times 100$$

Data obtained from studies were subjected to analysis of variance after appropriate transformations.

RESULTS

Effect on oviposition : when treated seeds were exposed to insects after 30 and 90 days of storage, more eggs were laid in control than the treated seeds. With 150 days storage period, the oviposition in control was the same as in case of any of the oils (Table 1). It was interesting to observe that in case of seed treatment with coconut, the number of eggs laid was more than in the control. Irrespective of the oils, seeds treated 2 ml oil/kg were preferred for egg lying in comparison with seeds treated at 4 ml oil/kg seed after 30 days as well as 90 days storage, whereas after 150 days storage, both doses were preferred equally for egg laying.

Thirty days after of application at sunflower oil 4 ml/kg 134.7 eggs/10 g were detected, while coconut oil treated seeds had 307 eggs/10 g and were most preferred for egg laying. At 2 ml/kg of, *taramira* and coconut oils, 234.2 eggs and 491.0 eggs respectively were detected.

Ninety days after treatment with seeds treated at 4 ml oil/kg, sunflower oil treated seeds had 175.3 eggs/10 g and was less preferred. This number was less than those laid on palm and coconut oils treated seeds. Coconut (510.0 eggs) oil treated seeds were most preferred for egg laying by the beetles. When seeds treated with 2 ml oil/kg seed were exposed for egg laying then sesamum oil treated seeds had 260.2 egg which was less than those laid on soybean and coconut oils treated seeds.

One hundred fifty days after treatment, considering the effect of individual dose of different oils, all oils were equally preferred for egg laying.

Effect on development : data regarding effect of oils on F_1 adult emergence or development indicated that always more number of F_1 adults emerged from untreated than treated seeds. Irrespective of the oils, emergence of adults from seeds treated at doses 2 and 4 ml/kg seed indicated that higher dose was always more effective in retarding development than lower ones (Table 2).

Thirty days after oil application at 4 ml/kg seed palm, mustard, rapeseed, *taramira*, groundnut and coconut oils almost inhibited development completely. Maximum adults developement was observed in soybean (51.7), sunflower (46.7), and sesamum (45.7) oil treated seeds. And when oils were used 2 ml/kg seeds, then palm, rapeseed, groundnut, coconut and *taramira* oils almost inhibited developement completely. Maximum developement of adults was observed in soybean (165.0), sesamum (156.0), and sunflower (125.25) oil treated seeds.

Table I. Efficacy of different edible plant oils at two doses against oviposition of *C. chinensis* on chickpea seeds at different storage intervals after treatment

Name of the oil	No. of eggs laid/10 g of seed after 30 days			No. of eggs laid/10 g of seed after 90 days			No. of eggs laid/10 g of seed after 150 days		
	2 ml/kg	4 ml/kg	Mean	2 ml/kg	4 ml/kg	Mean	2 ml/kg	4 ml/kg	Mean
Palm	245.7	162.7	204.2	381.0	399.0	390.0	409.0	435.5	422.2
Mustard	329.0	214.7	271.9	389.5	330.0	359.5	457.5	407.0	432.2
Rapeseed	367.2	216.2	291.7	435.2	246.7	341.0	483.0	365.5	424.2
Taramira	234.2	229.5	232.0	327.2	315.7	321.5	373.7	336.0	354.9
Groundnut	252.5	208.7	230.6	327.2	262.5	294.9	443.7	289.2	366.5
Coconut	491.0	307.0	399.0	584.0	510.0	547.0	602.7	588.5	595.6
Sesamum	248.7	147.2	198.0	260.2	189.2	224.7	311.5	310.0	310.7
Sunflower	332.2	134.7	233.5	335.7	175.3	255.6	342.7	214.5	278.6
Soybean	369.0	187.0	278.0	466.0	290.0	378.0	425.0	221.5	323.2
Mean	318.9	210.3	–	392.4	310.8	–	427.6	354.8	–
Control (untreated)		609.7			592.0			374.7	
C.D. at 5%	Treatment		86.46			135.07			162.14
	Level (L)		40.76			63.67			–
	T x L		122.27			191.07			–

Table II. Efficacy of different edible plant oils at two doses against development of *C. chinensis* chickpea seeds at different storage intervals after treatment

Name of the oil	No. of F_1 adults emerged from 10 g of seed after 30 days			No. of F_1 adults emerged from 10g of seed after 90 days			No. of F_1 adults emerged from 10g of seed after 150 days		
	2 ml/kg	4 ml/kg	Mean	2 ml/kg	4 ml/kg	Mean	2 ml/kg	4 ml/kg	Mean
Palm	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	1.00 (1.35)	0.00 (1.00)	0.50 (1.17)	7.25 (2.54)	0.25 (1.10)	3.74 (1.82)
Mustard	42.25 (6.32)	0.00 (1.00)	21.12 (3.66)	54.27 (7.37)	0.00 (1.00)	27.12 (4.18)	137.75 (11.51)	3.50 (1.90)	70.62 (6.70)
Rapeseed	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	19.00 (4.17)	2.75 (1.59)	10.87 (2.88)	98.75 (8.96)	14.00 (3.72)	56.37 (6.34)
Taramira	2.00 (1.61)	0.00 (1.00)	1.00 (1.30)	12.50 (3.39)	0.00 (1.00)	6.25 (2.19)	48.00 (6.09)	4.25 (2.07)	26.12 (4.08)
Groundnut	1.00 (1.36)	0.00 (1.00)	0.50 (1.18)	9.75 (2.94)	0.00 (1.00)	4.87 (1.97)	26.00 (5.06)	1.00 (1.39)	13.50 (3.22)
Coconut	2.00 (1.66)	0.50 (1.18)	1.25 (1.42)	13.50 (3.34)	2.50 (1.72)	8.00 (2.53)	25.50 (4.46)	2.50 (2.45)	14.00 (3.45)
Sesamum	156.50 (12.50)	45.75 (6.22)	101.20 (9.36)	101.75 (10.03)	60.00 (7.16)	80.87 (8.59)	152.00 (11.90)	98.50 (9.83)	125.25 (10.86)
Sunflower	125.25 (10.87)	46.75 (6.64)	86.00 (8.75)	90.75 (9.62)	64.50 (7.79)	80.12 (8.70)	199.25 (14.08)	91.00 (9.58)	145.12 (11.83)
Soybean	165.00 (12.79)	51.75 (7.16)	108.37 (9.97)	165.50 (12.87)	122.75 (10.54)	144.12 (11.70)	149.25 (12.22)	107.50 (10.01)	128.37 (11.11)
Mean	56.90 (5.50)	16.10 (2.90)	-	52.60 (6.10)	28.00 (3.80)	-	122.80 (8.60)	35.80 (4.70)	-
Control (untreated)			254.75 (16.70)			265.00 (16.21)			262.00 (16.28)
CD at 5%	Treatment(T)		1.46			2.01			2.32
	Level (L)		0.69			0.95			1.09
	TxL		2.06			2.84			3.28

Figures in parentheses are n+1 transformation

Table III. Efficacy of different edible plant oils at two doses as protectants of chickpea from weight loss due to infestation of *C. chinensis* at different storage intervals after treatment

Name of the oil	Per cent loss in weight after 30 days			Per cent loss in weight after 90 days			Per cent loss in weight after 150 days		
	2 ml/kg	4 ml/kg	Mean	2 ml/kg	4 ml/kg	Mean	2 ml/kg	4 ml/kg	Mean
Palm	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.23 (4.80)	0.00 (4.05)	0.11 (4.42)	1.50 (7.44)	0.04 (4.05)	0.77 (5.74)
Mustard	8.70 (17.09)	0.00 (4.05)	4.35 (10.57)	10.80 (19.55)	0.00 (4.05)	5.40 (11.80)	26.85 (31.27)	0.73 (6.07)	13.80 (18.67)
Rapeseed	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	3.95 (11.52)	0.37 (5.21)	2.16 (8.37)	19.33 (24.24)	6.10 (13.83)	12.71 (19.03)
Taramira	0.40 (5.35)	0.00 (4.99)	0.20 (4.60)	2.57 (9.50)	0.00 (4.05)	1.28 (6.77)	9.45 (16.53)	0.83 (6.25)	5.14 (11.39)
Groundnut	0.48 (5.92)	0.00 (4.65)	0.24 (4.98)	1.77 (8.15)	0.00 (4.05)	0.88 (6.10)	5.28 (13.62)	0.20 (4.77)	2.74 (9.19)
Coconut	0.85 (6.44)	0.24 (4.74)	0.54 (5.59)	2.55 (9.44)	0.55 (5.65)	1.55 (7.54)	5.13 (12.22)	1.35 (7.29)	3.14 (9.75)
Sesamum	31.10 (34.15)	11.60 (16.73)	21.35 (25.44)	20.30 (27.02)	11.99 (19.38)	16.14 (23.20)	29.77 (33.08)	19.20 (26.07)	24.48 (29.57)
Sunflower	14.45 (21.98)	9.05 (17.89)	11.75 (19.93)	15.32 (22.53)	12.95 (21.16)	14.13 (21.84)	38.65 (38.57)	18.15 (25.57)	28.40 (32.11)
Soybean	33.00 (35.54)	10.57 (19.20)	21.78 (27.37)	32.70 (35.01)	16.25 (28.87)	24.47 (31.94)	29.40 (33.08)	21.20 (29.95)	25.30 (31.51)
Mean	9.70 (14.90)	3.50 (10.70)	-	10.00 (16.40)	9.00 (10.70)	-	18.40 (23.30)	7.50 (13.40)	-
Control (untreated)			47.90 (44.07)			51.15 (45.45)			49.57 (45.06)
CD at 5%	Treatment		3.39			5.06			6.23
	Level (L)		1.60			2.38			2.94
	T x L		4.79			7.16			8.82

Figures in parentheses = Arc Sin value of (n + 0.5)

Table IV. Efficacy of different edible oils at two doses as protectants of chickpea from seed damage due to infestation of C. chinensis at different storage interval after treatment

Name of the oil	Per cent damaged seed after 30 days			Per cent damaged seed after 90 days			Per cent damaged seed after 150 days		
	2 ml/kg	4 ml/kg	Mean	2 ml/kg	4 ml/kg	Mean	2 ml/kg	4 ml/kg	Mean
Palm	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	2.20 (8.18)	0.00 (4.05)	1.10 (6.11)	15.62 (20.36)	0.25 (4.69)	7.93 (12.57)
Mustard	42.39 (40.59)	0.00 (4.05)	21.14 (22.32)	67.14 (57.75)	0.00 (4.05)	33.57 (30.90)	96.67 (80.14)	6.97 (13.14)	51.82 (46.64)
Rapeseed	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	33.80 (35.17)	3.76 (10.86)	18.78 (23.01)	68.72 (58.21)	27.34 (31.14)	48.03 (44.67)
Taramira	1.04 (6.00)	0.00 (4.05)	0.52 (5.02)	23.97 (28.29)	0.00 (4.05)	11.98 (16.17)	46.27 (43.38)	8.84 (15.71)	27.55 (29.54)
Groundnut	2.12 (8.28)	0.00 (4.05)	1.06 (6.16)	15.63 (22.57)	0.00 (4.05)	7.81 (13,31)	43.78 (41.61)	2.20 (8.89)	22.99 (25.25)
Coconut	4.16 (11.40)	1.08 (6.20)	2.62 (8.80)	23.55 (26.50)	5.63 (11.95)	14.59 (19.22)	33.50 (34.55)	13.06 (18.86)	23.28 (26.70)
Sesamum	84.04 (67.40)	51.63 (42.04)	67.83 (57.71)	80.39 (65.10)	67.61 (57.88)	74.00 (61.49)	93.40 (76.59)	84.08 (68.60)	88.74 (72.59)
Sunflower	77.98 (63.67)	55.55 (48.77)	66.76 (56.22)	81.39 (65.25)	71.79 (59.95)	76.59 (62.60)	98.36 (83.37)	83.68 (66.74)	91.02 (75.05)
Soybean	75.81 (60.93)	93.31 (74.50)	84.56 (62.71)	95.59 (79.17)	74.06 (61.30)	84.82 (70.23)	95.01 (78.01)	80.68 (65.77)	87.84 (71.89)
Mean	33.80 (30.80)	20.50 (19.8)	-	47.10 (42.90)	24.80 (24.20)	-	55.70 (49.90)	34.10 (32.60)	-
Control (untreated)			98.23 (84.22)			100.00 (90.00)			97.44 (84.21)
CD at 5%	Treatment (T)		6.44			9.84			12.58
	Level (L)		3.04			4.64			5.93
	T x L		9.11			13.92			17.79

Figures in parentheses = Arc Sin value of (n + 0.5)

Ninety days after oil application, at 4 ml/kg seeds palm, mustard, rapeseed, *taramira*, groundnut and coconut oils inhibited almost development completely, whereas soybean and sunflower oils followed by sesamum were least effective in inhibiting developement. At 2 ml/kg seed of oil application, none of the oils inhibited developement completely. Palm, groundnut, coconut and *taramira* followed by mustard and rapeseed proved very effective while soybean oil followed by sunflower and sesamum proved least effective in inhibiting development.

One hundred fifty days after treatment, at 4 ml/kg seed of oil application palm, groundnut, *taramira*, mustard, coconut and rapeseed inhibited emergence of beetles more effectively than soybean, sesamum and sunflower oils. And when oils were used 2 ml/kg, palm and coconut followed by groundnut, *taramira* and rapeseed proved to be most effective. On the other hand, sunflower, soybean, sesamum and mustard oils were found to be least effective in inhibiting emergence of F_1 adults.

Effect on weight loss and seed damage : always more weight loss and seed damage (Tables 3 and 4) due to *C. chinensis* infestation was observed in untreated than with treated seeds. From ml/kg was always better in reducing weight loss and seed damage than 2 ml oil/kg. The order of efficacy of different oils, when used 2 and 4 ml/kg seed in reducing weight loss and seed damage at each storage interval was almost similar to that observed in retarding development at respective storage intervals.

DISCUSSION AND CONCLUSIONS

Less oviposition occured on seeds treated with oils irrespective of dose after different storage intervals. Our observations on reduced egg laying are in agreement with the report of **Pandey** and **Verma** (1979) who used oils on black and green gram at 0.3 % for the control of pulse beetles. The deleterious effects of palm oil against oviposition also are in agreement with the report of **Sujatha** and **Punnaiah** (1985) who used the oil at 0.25 % on green gram seeds. **Doharey** *et al.* (1985) also observed less oviposition on green gram treated with *taramira* oil at 0.10, 0.25 and 1.0 per cent levels. The reduced oviposition of bruchid anpulses treated with soybean oil at 0.5 and 1.0 per cent was observed by **Schoohnoven** (1977).

Results with groundnut, mustard and sunflower oils to reduce emergence of adults, are in agreement with those obtained by **Mummingati** and **Ragunathan** (1977) who used these oils on greengram at 0.05 to 0.5 per cent. Results of palm oil were similar to those of **Sujatha** and **Punniah** (1985).

Present results with regard to coconut, groundnut, mustard, *taramira*, sesamum and sunflower oils to reduce weight loss and seed damage, are similar to the findings of **Doharey** *et al.* (1985) who reported sunflower oil as least effective followed by sesamum, mustard, groundnut and *taramira* oils while coconut oils was the best protectant. Lower infestation of *C. chinensis* in green gram seeds treated with palm, groundnut and coconut oils, as reported by **Sujatha** and **Punnaiah** (1985), is also in agreement with the present results. However, results of sesamum oil are quite contrary to those reported by **Sujatha** and **Punnaiah** (1985). Results obtained in the case of soybean oil to reduce emergence of adults and subsequently weight loss and seed damage, are in agreement with those obtained by **Schoohoven** (1978) and **Cruz** and **Cardona** (1981).

It may concluded that irrespective of the oils, seeds treated 2 ml oil/kg were preferred more for oviposition in comparison to seeds treated at 4 ml/kg after 30 days as well as 90 days after treatment, whereas 150 days after treatment both the doses were equally preferred for oviposition. At 2 ml/kg dose, palm, rapeseed, groundnut, coconut and *taramira* oil could inhibit development almost completely, weight loss and seed damage only after 30 days of oil treatment. While at 4 ml/kg dosepalm, mustard, rapeseed, *taramira*, groundnut and coconut oils provided almost complete protection after 30 days as well as 90 days after treatment. Whereas after 150 days, none of the oils could provide complete protection at any dose. However, palm groundnut, mustard, *taramira* followed by coconut and rapeseed could be grouped as most effective while sunflower, sesamum and soybean as least effective at 4 ml/kg chickpea seed, for control of *C. chinensis*.

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EVALUATION DE CERTAINES HUILES COMESTIBLES POUR LA PROTECTION DU POIS CHICHE *C. ARIETINUM* L. CONTRE LA BRUCHE *CALLOSOBRUCHUS CHINENSIS* (L.) GRACE A LA METHODE DE L'ALIMENTATION PREFERENTIELLE

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Résumé

Après avoir stocké des graines traitées de *Cicer arietinum* pendant des durées différentes, on a entrepris de mesurer sur elles l'effet protecteur de l'huile de moutarde, de colza, de *Taramina*, d'arachide, de noix de coco, de sésame, de tournesol, de soja et de palme, utilisées à 2 et 4 ml/kg de graines, contre la ponte, le développement, les dégradations du grain et les pertes en poids occasionnées par *C. chinensis*. Les coléoptères ont montré une préférence pour les semences non traitées pour y pondre leurs oeufs lorsqu'ils avaient le choix, après 30 jours comme après 90 jours de traitement, tandis qu'après 150 jours ils ne faisaient plus la différence entre les deux types de graines. Sans tenir compte du type d'huile, les coléoptères ont pondu plus d'oeufs lorsque les pois chiches avaient été traités par 2 ml d'huile et stockés pendant 30 à 90 jours que lorsque le traitement avait été effectué à la dose de 4 ml. Après un stockage d'une durée de 150 jours, de telles différences n'étaient plus significatives. Il y a eu une multiplication des coléoptères, donc une augmentatin de la perte de poids et de la détérioration du grain non traité par rapport au grain traité. Sans tenir compte du type d'huile, la dose de 2 ml a toujours été moins efficace sur la réduction de la multiplication, de la perte de poids et de la détérioration du grain que la dose de 4 ml/kg. A la dose de 2 ml/kg, l'huile de palme, de colza, d'arachide, de noix de coco et de *Taramina* ont été capables d'inhiber presque complètement le développement, la perte de poids et la détérioration après 30 jours seulement. Tandis qu'à la dose de 4 ml/kg, l'huile de palme, de moutarde, de colza, de *Taramira*, d'arachide et de noix de coco ont conféré une protection presque complète après 30 jours aussi bien qu'après 90 jours de traitement. Mais, après 150 jours, aucune huile n'a pu conférer une totale protection à n'importe quelle dose. Cependant, les huiles de palme et de noix de coco se sont nettement avérées avoir le potentiel le plus élevé et étaient suivies par les huiles d'arachide, de colza, de *Taramina* et de moutarde. D'autre part, les huiles de sésame, de tournesol et de soja se sont avérées inférieures aux autres.