Effect of Verticillium Wilt on Root and Top Weight of Peanut Cultivar Tamnut 74

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ABSTRACT

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The effect of *Verticillium dahliae* on root and top weight and peg production of peanut cultivar Tamnut 74 (*Arachis hypogaea* L.) was examined in the greenhouse using two inoculation techniques. Plants inoculated when either 4, 6, 8, or 12 wk old by a root-dip method or stem injection had significantly reduced top and root dry weights and total pegs per plant or pegs with fruits. When plants were examined for foliar symptoms, generally, the earlier the inoculation by either method, the more severe the symptoms. It is concluded that Verticillium infection of peanuts, regardless of the plant age, can cause significant loss in plant vigor and reproduction capacity.

Verticillium wilt of peanut (*Arachis hypogaea* L.), caused by *V. dahliae* Kleb., has been reported from various peanut-growing regions of the world (2,5). In the United States, this disease is mainly confined to certain parts of the peanut-growing areas in New Mexico and Oklahoma (6,7), where it is considered an economically important disease. Early symptoms consist of marginal chlorosis of leaflets, leaf epinasty, and flacidity. Later symptoms consist of stunting, general yellowing, leaf necrosis, wilting, leaf defoliation, and eventual dehydration of infected plants.

In this paper, we report on the effect of Verticillium infection on root and top weight and production of pegs in peanut cultivar Tamnut 74 under greenhouse conditions. Part of this research has been reported (4).

MATERIALS AND METHODS

The monoconidial isolate of *V. dahliae* used in this study was from the stem of a diseased peanut plant (cultivar Comet) and maintained in the dark at 24 ± 1 C on

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Table 1. Effect of *Verticillium* infection on root and top weight of plants of the peanut cultivar Tamnut 74

Plant age (wk) and method of inoculation	Mean top dry weight (g) per plant[a]		Mean root dry weight (g) per plant[a]	
	Inoculated	Uninoculated	Inoculated	Uninoculated
4 R[b]	1.37	4.72	0.28	1.55
LSD[c]	1.16		0.42	
4 S[d]	10.00	13.76	2.00	3.47
LSD	1.60		0.86	
6 R	1.52	4.33	0.56	1.52
LSD	0.85		0.42	
6 S	9.67	12.99	1.48	2.59
LSD	1.89		0.58	
8 R	3.01	4.59	1.00	1.48
LSD	0.98		0.36	
8 S	9.72	13.12	1.67	3.03
LSD	2.35		0.68	
12 R	1.93	3.96	0.71	1.15
LSD	0.96		0.35**	
12 S	9.26	12.41	1.77	2.61
LSD	1.82		0.75	

[a] Fifteen plants per treatment.

[b] R = root dip. Inoculation was by immersing roots for 45 min in a conidial suspension (1×10^6 conidia/ml) of *V. dahliae*. Data were collected 60 days after inoculation.

[c] LSD = least significant difference. All values significant at $P = 0.01$ except ** = $P = 0.05$.

[d] S = stem injection. Inoculation was by injecting the stem at the base of each plant with 0.5 ml of conidial suspension (0.5×10^6 conidia/ml) of *V. dahliae*. Data were collected 90 days after inoculation.

Table 2. Effect of Verticillium infection on the production of pegs by the peanut cultivar Tamnut 74

Plant age (wk) and method of inoculation	Mean number of total pegs per plant[a]		Mean number of pegs with fruits per plant[a]	
	Inoculated	Uninoculated	Inoculated	Uninoculated
4 R[b]	1.30	6.60	1.06	5.13
LSD[c]	2.70		2.46	
4 S[d]	22.20	26.20	19.33	22.66
LSD	3.11**		2.58**	
6 R	2.93	5.97	2.40	3.53
LSD	2.22		1.31*	
6 S	26.4	28.87	24.00	29.00
LSD	4.57*		4.92	
8 R	5.13	6.33	3.13	4.80
LSD	1.56*		1.40	
8 S	26.20	31.67	24.73	27.93
LSD	4.37		2.82	
12 R	6.87	10.93	6.27	9.00
LSD	2.8		2.59	
12 S	29.73	32.47	26.00	30.47
LSD	3.01*		4.17	

[a] Fifteen plants per treatment.
[b] R = root dip. Inoculation was by immersing roots for 45 min in a conidial suspension (1×10^6 conidia/ml) of *V. dahliae*. Data were collected 60 days after inoculation.
[c] LSD = least significant difference. All values significant at $P = 0.01$ except * = $P = 0.10$ and ** = $P = 0.05$.
[d] S = stem injection. Inoculation was by injecting the stem at the base of each plant with 0.5 ml of conidial suspension (0.5×10^6 conidia/ml) of *V. dahliae*. Data were collected 90 days after inoculation.

potato-dextrose agar containing streptomycin sulfate (100 μg/ml). Conidial preparations were obtained as described by Melouk and Horner (3).

For root inoculation, seeds of cultivar Tamnut 74 without fungicides were germinated on moist paper towels in darkness at 29 ± 2 C for 48 hr. Fifteen seedlings with uniform radicles were planted in each of several wooden flats (35 × 50 × 9 cm) containing a mixture of soil, finely shredded peat, and sand (1:1:1, v/v/v). Flats were placed in a greenhouse maintained at 28 ± 2 C during the day and 22 ± 2 C at night. Three weeks after planting, seedlings were fertilized by adding 400 ml of 0.2% ammonium nitrate and 400 ml of Hoagland's solution (1) to each flat. Plants were grown for 4, 6, 8, or 12 wk before inoculation. For inoculation, plants were gently uprooted and roots rinsed thoroughly with tap water, then immersed for 45 min in a conidial suspension (1×10^6 conidia per milliliter) of *V. dahliae*. Plants were then transplanted into 16.5-cm pots containing a mixture of soil, peat, and sand (4:1:5, v/v/v) and maintained at the conditions described earlier.

For stem inoculation, seeds of Tamnut 74 were germinated as described and seedlings with uniform radicles were each planted in a 16.5-cm pot containing a mixture of soil, peat, and sand (4:1:5, v/v/v). Three weeks after planting, each seedling was fertilized with 50 ml of 0.2% ammonium nitrate and 50 ml of Hoagland's solution (1). Plants were grown for 4, 6, 8, or 12 wk, then inoculated by injecting the stem at the base of each plant with 0.5 ml of conidial suspension (0.5×10^6 conidia per milliliter) of *V. dahliae* using a syringe with a 23-gauge hypodermic needle.

Sixty and 90 days after root and stem inoculation, respectively, aerial parts and roots were separated and the total number of pegs per plant determined. Roots and aerial parts were dried for 15 min in a microwave oven at maximum power. Percent reduction in weights and pegs were calculated as follows:

$$1 - \frac{\text{mean value in inoculated}}{\text{mean value in uninoculated}} \times 100$$

A subjective scale of 1–5 was used to describe Verticillium wilt severity on plants, where 1 = no symptoms, 2 = leaf chlorosis and/or necrosis on 10–20% of the leaves, 3 = leaf chlorosis and/or necrosis on 50% of the leaves, 4 = stunted and wilted with chlorosis and/or necrosis on more than 50% of the leaves, and 5 = dead plants.

Each age group of plants for each inoculation method consisted of 15 inoculated and 15 uninoculated plants arranged in a completely randomized design. Data were analyzed by standard procedures for analysis of variance.

RESULTS AND DISCUSSION

The deleterious effects of *Verticillium* on weight and reproduction of the peanut cultivar Tamnut 74 were observed under controlled greenhouse conditions (Tables 1 and 2). Inoculation by the stem-injection method significantly reduced (by 27, 26, 26, and 25%) the top dry weight of plants inoculated when 4, 6, 8, and 12 wk old, respectively. Significant reductions of 42, 43, 45, and 32% in the root dry weight were also recorded in plants inoculated when 4, 6, 8, and 12 wk old, respectively. Reductions in the total number of pegs and pegs with fruits (in parentheses) were 15 (15), 9 (17), 17 (11), and 8 (15)% in plants inoculated when 4, 6, 8, and 12 wk old, respectively. The stem-injection method resulted in mild to moderate wilt symptoms, where mean disease index 90 days after inoculation was 1.9, 3.3, 3.2, and 2.5 for plants inoculated when 4, 6, 8, and 12 wk old, respectively.

Inoculation by the root-dip method significantly reduced top dry weight by 71, 65, 34, and 51% in plants inoculated when 4, 6, 8, and 12 wk old, respectively. Significant reductions in root dry weights of 82, 63, 32, and 38% were noted in plants inoculated when 4, 6, 8, and 12 wk old, respectively. Reductions in the total number of pegs and pegs with fruits (in parentheses) were 80 (79), 51 (32), 19 (35), and 37 (30)% in plants inoculated when 4, 6, 8, and 12 wk old, respectively.

Moderately severe wilt symptoms developed on root-dip-inoculated plants. The mean disease index 60 days after inoculation was 3.9, 3.7, 3.7, and 3.5 for plants inoculated when 4, 6, 8, and 12 wk old, respectively. The root-dip inoculation procedure necessitated transplanting and resulted in severe shock. This is evident when the data in Table 1 on dry weight of root and top of root-dip-inoculated and uninoculated plants are compared with data from the uninoculated plants and stem-injected plants. In addition, it is evident when the data on total number of pegs and pegs with fruits of root-dip-inoculated and uninoculated plants are compared with data from uninoculated and stem-injected plants (Table 2).

Regardless of the time of infection, Verticillium wilt reduced vigor and reproduction capacity in Tamnut 74. In this greenhouse experiment, peanut plants were maintained under favorable conditions for growth. Therefore, Verticillium wilt may contribute to substantial pod loss when Tamnut 74 is grown under the additional stress of actual field conditions.

LITERATURE CITED

1. Hoagland, D. R., and Arnon, D. I. 1950. The water-culture method for growing plants without soil. Calif. Agric. Exp. Stn. Circ. 347. 32 pp.
2. Jackson, C. R., and Bell, D. K. 1969. Diseases of peanut (ground-nut) caused by fungi. Univ. Ga. Coll. Agric. Exp. Stn. Res. Bull. 56. 137 pp.
3. Melouk, H. A., and Horner, C. E. 1975. Cross protection in mints by *Verticillium nigrescens* against *V. dahliae*. Phytopathology 65:767-769.
4. Melouk, H. A., and Wadsworth, D. F. 1981. Effect of plant age on the susceptibility of the peanut cv. Tamnut 74 to Verticillium wilt. (Abstr.) Proc. Am. Peanut Res. Ed. Soc. 13:90.
5. Purss, G. S. 1961. Wilt of peanut (*Arachis hypogaea* L.) in Queensland with particular reference to Verticillium wilt. Queensl. J. Agric. Sci. 18:453-462.
6. Smith, T. E. 1960. Occurrence of Verticillium wilt on peanuts. Plant Dis. Rep. 44:435.
7. Wadsworth, D. F. 1973. Research on the nature and control of peanut diseases in Oklahoma. Okla. Agric. Exp. Stn. Res. Rep. P. 683. 17 pp.