Effect of Four Phenolic Compounds on Yield, Yield Characteristics and Oil Production of Two Peanut (*Arachis hypogaea* L.) Cultivars[1]

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ABSTRACT

In the recent years phenolics have gained importance as PGR(s) [plant growth regulators]. To study their effect on pod development in peanut, four phenolic compounds (H-acid, 1, 2, 4-acid, resorcinol, and RD-Brown) were used in a field experiment with two foliar spray applications of 100 and 200 ug/mL at 35 and 50 days after planting. A randomized block design was used separately for two cultivars (C-501 and M-37 with three replications for each treatment. All treatments resulted in increased oil content and yield (kg/ha) of peanut (*Arachis hypogaea* L.). H -acid at 100 ug/mL was the most effective treatment for enhancing number of pods per plant, shelling percentage, yield (kg/ha) and oil percentage in C-501. While H-acid at 100 ug/mL gave the highest increase in number of pods/plant and oil percentage, resorcinol induced the highest yield per hectare and total oil content in M-37. The effect of phenolic compounds on these peanut parameters was independent of their structural configuration.

Key Words: Phenols, H-acid, 1, 2, 4-acid, resorcinol, RD-Brown, foliar spray, *Arachis hypogaea*, oil content, shelling percentage.

The use of phenolics for plant growth regulation has been reported for several decades (1, 6, 20, 23). However, during the last decade, their use has been expanded to several plant processes (2, 6, 7, 12, 13) with beneficial results (21, 23). In earlier work we reported that some of the phenolic compounds (monophenols) were highly effective for yield improvement in some peanut cultivars, viz. M-13, M-145 and PG No. 1 (14, 16, 17). In an extension of these observations, a study was conducted to evaluate the effect of four commercial phenols (2 mono- and 2 diphenols) on yield, yield characteristics (viz. number of gynophores/plant, shelling percentage and number of pods/plant) and total oil percentage of two peanut cultivars.

Materials and Methods

Seed of two peanut cultivars (spreading M-37 and semi-spreading C-501) was obtained from the Department of Plant Breeding and field experiments were conducted during the year 1983 and 1985 in the Department of Botany, Punjab Agricultural University, Ludhiana. Randomized block design was used for both the cultivars separately with 3 replications of each treatment in a plot size of 4.5 x 3 metres. Sowing was done on July 1, 1983 and July 3, 1985. Soil was loamy sand having pH 8.1, EC 0.25 mmhos/cm. Nutrients were applied @ Nitrogen (15 kg/ha), P_2O_5 (20 kg/ha), and Gypsum broadcast (125 kg/ha). Three irrigations were applied to the crop. The details of phenolic compounds used (structure; common and technical name; molecular weight; solubility) are given in Table 1. Solutions of different phenolic compounds were prepared by dissolving the phenols in a few drops of ethanol and then the final volume was adjusted with water.

Two sprays were applied 35 and 50 days after planting (DAP) at 100 and 200 ug/mL concentration with the different phenolic compounds, viz. monophenols (H-acid and 1,2,4-acid) and diphenols (Resorcinol and RD-Brown). Controls comprised spraying with distilled water alone (Table 1). Experimental plots were sprayed with a foot-sprayer @ 500 litres of solution per hectare. Shelling percentage (weight of kernels/weight of total pods x 100, and yield in kg/ha were recorded at the time of harvest (120 DAP). Also five plants at harvest were selected from each plot for recording the data on the number of pods per plant and gynophores (including pods) per plant. Oil in the kernels was determined by the method of Kartha and Sethi (9). Total oil yield was calculated by multiplying yield (kg/ha) by oil percentage.

Table 1. Chemistry data of the four phenolic compounds studied.

Category	Common name	Chemical name of phenolic compounds	Concentration used (μg/ml)	Mol wt.
I. Monophenols	H-acid	8-amino; 3, 6, disulphate α-naphthol	100 200	319 "
	1, 2, 4-acid	1-amino, 4 sulphonate, β - naphthol	100 200	239 "
II. Diphenols	Resorcinol	1, 3 dihydroxy benzene	100 200	110 "
	RD-Brown	4, 6-Bis-(Diazo napthalene sulphonate)-Resorcinol	100 200	622 "
III. Control	Distilled water	H_2O	-	-

Results

Cultivar C-501 (Semi-Spreading Growth Type)

The number of gynophores/plant increased significantly with resorcinol, H-acid, 1, 2, 4-acid at both concentrations and with RD-Brown at 100 ug/mL only over that of the control (Table 2). Number of total pods/plant also increased significantly with all the phenols, except RD-Brown. A significant increase in shelling percentage occurred only with H-acid (100 ug/mL) and RD-Brown at both concentrations. The H-acid treatment not noly increased the number of total pods/plant but also the pods with larger kernels. Shelling percentage in other treatments was not affected, implying that these treatments did not increase the kernel size. Yield was significantly higher (17.4% higher than the control) for H-acid (100 ug/mL) and 1, 2, 4-acid at both the concentrations. Though the number of total pods/plant in these treatments was not as high as with H-acid (200 ug/mL) or resorcinol (100 ug/mL), these treatments provided higher yields because of higher shelling percentage, i.e. relative increased weight of their kernels. H-acid also gave a high percentage of oil (although non-significantly different from the control) but with improved yields produced the highest total oil yield (oil percentage x yield in kg/ha).

Cultivar M-37 (Spreading Type)

The number of gynophores increased significantly over the control with all the phenolics, except H-acid (200 ug/mL), although the higher concentrations of the respective phenol always gave lower values than lower concentration,

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Table 2. Effect of monophenols (H-acid, 1, 2, 4-acid) and diphenols (resorcinol, RD-Brown) on yield, oil and shelling percentage of C-501 (semi-spreading).

Phenolic compounds (µg/ml)		No. of gynophores/ plant		Number of pods/plant		Shelling percentage		Yield (kg/ha)		Oil percentage		Total oil yield (kg/ha)	
		1983	1985	1983	1985	1983	1985	1983	1985	1983	1985	1983	1985
MONOPHENOLS													
1. H-acid	:100	157*	149*	30*	34*	77.5*	72.4*	2430*	2410*	50.8	50.6	1234	1220
	200	152*	141*	36*	38*	72.0	71.9	2170	2200	50.7	50.4	1100	1115
2. 1, 2, 4-acid	:100	149*	146*	28*	31*	67.5	70.0	2268*	2290*	47.2	47.7	1070	1092
	200	157*	140*	28*	30*	71.3	70.8	2268*	2295*	47.2	48.0	1070	1102
DIPHENOLS													
3. Resorcinol	:100	179*	151*	33*	32*	70.5	69.8	2196	2205	49.4	49.8	1085	1098
	200	144*	150*	27*	29*	67.0	69.0	2118	2170	50.9	51.0	1078	1107
4. RD-Brown	:100	153*	142*	21	23	74.4*	73.0*	2079	2105	49.7	49.9	1033	1050
	200	126	121	20	21	74.4*	72.9*	2196	2200	51.1*	50.8	1122	1118
5. Control		122	119	17	18	68.0	67.8	2070	2085	47.6	47.9	985	999
L.S.D. at 1%		18.0	16.0	4.0	6.0	5.0	4.5	143.0	150.0	3.4	N.S.	-	-

except for RD-Brown where they were the same at both concentrations (Table 3). Total number of pods/plant increased significantly with H-acid (100 ug/mL), 1, 2, 4-acid (both concentrations) and resorcinol (100 ug/mL). The increase was not as great as in the semi-spreading C-501. In this cultivar, none of the treatments significantly increased shelling percentage showing no increase in the weight of kernels over that of control. All treatments caused a significant increase in yield with resrocinol causing the highest yield increase. All treatments except the high rate of resorcinol, increased oil percentage. The highest total oil yield was obtained with resorcinol (100 ug/mL and 41% over that of control) leading us to postulate that diphenols are more effective for the spreading type cultivars.

Discussion

The increase in the total number of pods/plant in the semi-spreading (C-501) and spreading (M-37) cultivars by H-acid and resorcinol shows specific and regulatory effects of these phenols, which is in conformity with earlier reports (14, 16, 17). Increase in gynophore numbers over the control also depicts an increase in the efficiency of pod formation by these treatments, which leads us to postulate that these phenols are active at lower concentrations and do not act as inhibitors as previously thought. Kefeli and Kutacek (10) and Malik *et al.* (15) have reviewed and assigned phenols physiological roles for which the mechanism of action may be via IAA (11), as coordinators, synergists or stimulators of plant growth substances. Though the increased total number

Table 3. Effect of four phenols on yield, oil and shelling percentage of M-37 (spreading type).

Phenolic compounds (µg/ml)		No. of gynophores/ plant		Number of pods/plant		Shelling percentage		Yield (kg/ha)		Oil percentage		Total oil yield (kg/ha)	
		1983	1985	1983	1985	1983	1985	1983	1985	1983	1985	1983	1985
MONOPHENOLS													
1. H-acid	:100	121*	122*	25*	28*	69.0	68.9	1844*	1900*	52.6*	52.0*	970	988
	200	83	95*	21	22	70.1	69.7	1754*	1742	52.1*	51.7*	914	901
2. 1, 2, 4-acid	:100	133*	129*	25*	29*	70.5	70.2	1988*	1902*	51.8*	60.9*	1030	968
	200	100*	99*	23*	20	70.0	69.8	1880*	1840*	51.1*	50.7*	961	933
DIPHENOLS													
3. Resorcinol	:100	127*	120*	25*	28*	72.0	70.0	2204*	2109*	51.9*	51.4*	1144	1084
	200	103*	100*	22	21	72.0	69.9	2168*	2098*	50.8	50.3	1101	1055
4. RD-Brown	:100	106*	102*	22	21	70.0	71.0	1916*	1800*	51.2*	50.2	987	904
	200	106*	100*	22	24	70.5	70.2	1844*	1788*	51.7*	51.0*	953	907
5. Control		85	82	19	20	68.4	68.2	1628	1632	49.8	49.5	811	808
L.S.D. at 1%		6.0	7.0	4.0	5.0	N.S.	N.S.	105	140	1.1	1.2	-	-

of gynophores produced did not lead to increased number of pods, there was a certain and definite increase in the process of pod formation with phenols in general. Earlier postulations (8) that a phenol having 2 OH groups at *ortho* position with a free *para* postion was essential for biological activity are not supported by this investigation. In our studies, both the monophenols appear to be biologically active since they increased pod yields significantly over the control. In recent years, several studies have shown a general lack of correlation between the effects of phenolic compounds on growth and development and their structural configuration (12, 13, 21, 22). In peanut if full pod load is established earlier and synchronous development of pods with continuous supply of photosynthates maintained, pods formed are larger (16). With phenolics treatments, we were able to accomplish the above mentioned characteristics. Early initiation of pods also leads to an increased filling period thereby yielding larger kernels and thus increased yields. Kefeli and Dashek (12) explained the mobilization of photosynthates from vegetative parts to the developing fruits by decreasing vegetative growth with phenols. Phenolics are known to cause changes in oil composition (19). The well marked effects of phenolic compounds on some yield parameters of rice (18), winter maize (22), peanut (14, 16, 17, 19), millet (4, 5) and triticale (3) have already been reported. Another interesting observation emanating from the present investigation is that the efficacy of the phenolics varies enormously and has to be specifically determined for specific crops. While both the monophenols were highly effective (at lower concentration) in the cultivar C-501. The monophenols and resorcinol (diphenol) were more effective in a spreading type cultivar (M-37).

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