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Use of Antioxidant Hydroquinone in the Control of Seed-borne Fungi of Peanut with Special Reference to the Production of Good Quality Seed

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Abstract: Pre-sowing treatment of peanut seeds with antioxidant hydroquinone with 20 mM water solution for 12 h significantly decreased the incidence of seed-borne fungi viz., *Aspergillus flavus*, *A. niger*, *Penicillium* spp., *Fusarium solani*, *F. oxysporum*, *Rhizoctonia solani*, *Sclerotium bataticola*, *Trichothicium* sp. and *Cladosporium* sp. *Cephalosporium* sp. and *Bipolaris* sp., were completely inhibited. Hydroquinone also enhanced the growth parameters viz., plant height, root length, shoot length, plant weight, root weight, shoot weight, number of branches, pegs, pods and dry weight of plant producing a 50% increase in yield from 1080 to 1555 kg/acre.

Key words: Hydroquinone, Antioxidants, Peanut, Seed-borne fungi Seed quality

Introduction

Plant diseases produce serious losses to peanut; an important leguminous crop in the third world. Of these, the disease transmitted through seed produce seed rot and affects the germinability of seed. Since fungicides used for the control of seed-borne diseases are hazardous to human health and environment, there is a need to develop alternative methods of plant disease control. During the course of our previous studies, a number of antioxidant were found effective in the control of seed-borne pathogens viz., *Cephalosporium* sp, *Fusarium moniliforme*, *F. oxysporum*, *F. solani*, *Rhizoctonia solani*, *Sclerotium bataticola* and *Verticillum* sp., which produce serious losses to peanut crop in Egypt. Soaking of seeds in 20 mM water solution of hydroquinone for 12 h before planting significantly decreased pre-emergence and post-emergence damping off caused by the seed-borne pathogens. Seedlings survival and plant vigor also showed an increase (Elwakil and El-Metwally, 2000).

Peanut seeds infected by seed-borne fungi have been reported to produce seed abortion, shrunken seeds, reduce seed size, seed rot, sclerotization of seeds, seed necrosis, seed discoloration, reduction of germination capacity and physiological alternation of seed (Neergaard, 1979). Considering the importance of peanuts as an important cash crop due to high quality of edible oil and protein, the peanut cultivated area in Egypt has increased 5 fold in 12

years from 12.327 ha in 1990 to 60.329 ha in 2001 (Anonymous, 2001). There is therefore need for an effective method for controlling seed-borne diseases of peanut with emphasis on the use of antioxidants which would not have adverse effect on the environment as compared to use of pesticides.

Due to the unique and sole growth manner of peanut seed, the prevalence of its infection by pathogens continue to increase. This attributes to the up-growth of seed in the soil which is usually full with soil inhabiting pathogens and these may attack seed at different stages of its growth. Subsequently, in the present study, an attempt has been made to use the antioxidant hydroquinone, instead of seed treatment by chemicals, not only to reduce the incidence of seed-borne fungi develop during the up-growth but also to improve the seeds of peanut qualitatively and quantitatively.

Materials and Methods

Seed samples

Peanut seed lot cv. Giza 4 which showed the presence of *Cephalosporium* sp, *Fusarium moniliforme*, *F. oxysporum*, *F. solani*, *Rhizoctonia solani*, *Sclerotium bataticola* and *Verticillum* sp., was used in this investigation.

Antioxidant

Hydroquinone was dissolved in tap water at 20 mM concentration and used for soaking peanut seeds for 12 h. The seeds were then air-dried for 2 h before planting.

Field trials

Four different plots containing sandy soil, each of one acre, located in the northern coast of Egypt (Dakhlia and Behera) were selected for this study.

Seed treatment

Seeds were treated for 12 h in 20mM hydroquinone then air dried for 2 h and sown in the selected field plots. Untreated seeds were soaked in tap water for 12 h and air dried for 2 h before sowing. All the recommended methods of planting, watering as well as agricultural practices including weed control were followed. No fertilizers were applied.

Harvesting

By the end of October 2001, plants were removed and the growth parameters including plant height, root and shoot length, plant weight, root and shoot weight, number of branches, pegs and pods, dry weight of the plant and yield were calculated.

Table 1: Growth parameters and yield of peanut raised from Hydroquinone treated seeds.

Growth parameters/yield	Check (intact healthy and untreated seeds)	Pre-examined infested seeds with 7 Pathogenic fungi and Hydroquinone treated (20mM)
Plant height (cm)	84.9b*	110.6a
Root length (cm)	13.7b	25.2a
Shoot length (cm)	71.2b	85.4a
Plant fresh weight (g)	227.0b	514.0a
Root fresh weight (g)	28.5b	54.0a
Shoot fresh weight (g)	198.5b	460.0a
No. of branches	9.4b	17.9a
No. of pegs	33.2b	71.4a
No. of pods	6.1b	20.6a
Dry weight/ plant (g)	30.8b	48.3a
Yield Kg/ Acre	1080.0b	1555.0a

*Within rows, means followed by different letters are significantly different at the 0.05 probability level

Table 2: Presence of fungi in seed samples after treatment with or without hydroquinone

Pathogen	Check %[1]	Hydroquinone %[2]
Aspergillus flavus	33.0a[3]	12.5b
Aspergillus niger	88.0a	41.0b
Penicillium spp.	77.5a	14.5b
Fusarium solani	17.5a	4.5b
Fusarium oxysporum	5.0a	0.5b
Rhizoctonia solani	2.5a	0.0b
Sclerotium bataticola	3.5a	2.5a
Trichothicium sp.	8.5a	2.5b
Cephalosporium sp.	4.5a	0.0b
Cladosporium sp.	6.5a	0.5b
Bipolaris sp.	1.5a	0.0a

[1]Check= Seeds harvested from the cultivated hydoquinone-untreated seeds

[2] Hydroquinone= Seeds harvested from the cultivated infected seeds but treated with hydroquinone before sowing.

[3] Within rows, means followed by different letters are significantly different at the 0.05 probability level.

Statistical analysis:

The data were analysed using analysis of variance (GLM procedure in PC-SAS software release 6:11; SAS Institute Inc., Cary, NC, USA.) using Duncan's multiple range test (DMRT) for treatment means comparisons.

Results

Treatment of peanut seeds with hydroquinone showed an increase in plant height, root length, shoot length, root fresh weight, shoot fresh weight, number of branches, pegs and pods per plant. Dry weight of the plants also increased. It is interesting to note that hydroquinone treatment showed a 50% increase in yield (Table 1, Fig. 1 and 2).

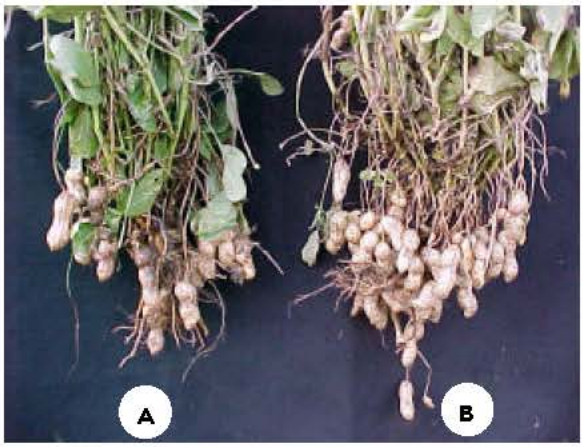

Fig. 1: Pod production of plant raised from peanut seed (A) untreated (B) treated with 20 mM hydroquinone

Fig. 2: Production of pods and seeds of one plant of peanut (A) raised from untreated seed, (B) treated with 20 mM hydroquinone

Seed health testing of the produced seeds

The harvested seeds of plants raised from hydroquinone treatment as well as from the check were examined for the presence of seed-borne fungi. Infection % of seed-borne fungi was considerably reduced in treatments where hydroquinone was used as compared to untreated seeds (Table 2). *Rhizoctonia solani*, *Cephalosporium* sp., *Bipolaris* sp., were completely inhibited in the hydroquinone treatment.

Discussion

The results of the present study would suggest that alternative methods for plant disease control especially of edible and underground produced peanut seeds should be exploited instead of indiscriminate use of pesticides which show harmful effects on human health and environment. The previous research by the author showed that the antioxidant hydroquinone is a promising safe chemical for controlling the seed-borne fungi of peanut. The present study showed that hydroquinone not only inhibits the seed-borne fungi but also has an effect in improving the growth of the plants and raise the yield by up to 50% more comparing to the untreated treatments. This phenomenon has also been shown by Chinese authors (Boeckx, ***et al.***, 2000) who indicated that hydroquinone function as urease inhibitor and improve the urea N recovery by spring wheat with 34% as compared to the treatment where only urea was applied. It also improved the quality (protein N content) of the grain. Moreover, antioxidants play an important role in expression of resistance in plant to pathogen attack (Larson, 1995; Jalali ***et al.***, 1999). This mutual effect for controlling the mycotoxin producing fungi as well as producing good quality seeds and raising the production by up to 50% is to be considered by the growers. The method is safe, simple, applicable and not costly. Hydroquinone (20 mM) which has a very low toxicity, Toxicity III, (Richard, 1995) may prove to have a significant effect in peanut production in future.

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