Research Article

Effect of Acetic Acid as Pre-plant Herbicide on *Arachis hypogaea L.* Germination

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ABSTRACT

Weeds are one of the most important constraints, which limit the production of groundnut in India. The competition between weed and *Arachis hypogaea L.* happened right after the early of growth so that weed control could be done from the beginning through the application of pre-plant herbicide. Limited data shown that vinegar (acetic acid) may have potential as a natural herbicide. Therefore the study was planned to determine the effect of acetic acid as pre-planting herbicide to the germination, early seedling growth and toxicity effect on *Arachis hypogaea L.* Concentration of acetic acid (0%, 10% and 20%) and timing of application 4th, 8th, and 12th days before planting. The results showed that acetic acid treatment did not significantly inhibit groundnut germination nor inhibit root growth. Pre-planting treatment generally does not inhibit the growth of shoot. The utilization of acetic acid was lower in 8th day (10%) than 12th day. So the Morphometric changes in 8th day (10%) was higher than 12th day (20%). The concentration of Carbohydrate, Protein and Chlorophyll were higher in 8th day (10%) than 12th day (20%). Higher concentration of acetic acid adversely affects the nodules. It was concluded that the pre-plant herbicides under investigation did not affect the groundnut plants adversely if used to recommend levels.

Keywords: Acetic acid, Pre-plant herbicide, *Arachis hypogaea L.*, Pot culture method.

INTRODUCTION

Vinegar, with acetic acid (CH_3COOH) as its main component, is potential as a natural herbicide added that acetic acid does not persist in the environment, but perishable with producing water as a by product.[1,2] The application of acetic acid found in soil (into microbial biomass or adsorbed to soil particles) of about 26% in the form of-COOH and 36% as-CH_3. Microbes have the special use of the C-CH_3 their growth, while the C-COOH groups tend to decarboxylation. Acetic acid in the soil provides a source of carbon for the decomposition process in producing carbon dioxide.[3]

According to that the acetic acid was absorbed into the plant and translocated to other parts plant of the inflict damage, therefore, it was considered to be a contact and as post-emergence herbicide as glycophosphate.[4,5] found that the pre-emergence application at 10% and 20% of the glacial acetic acid solution on *Arachis hypogaea L.* inhibited seed germination. No shoots and roots growth.

Herbicides are applied to the soil and are taken up by the roots and or hypocotyls of the target plant. There are three main types of soil–applied herbicides. Pre-plant incorporated herbicides are soil applied prior to planting and mechanically incorporated into the soil. The objective for incorporation is to prevent dissipation through photodecomposition and or volatility. Pre-emergent herbicides are applied to the soil before the crop emerges and prevent germination or early growth of weed seeds. Post-emergent herbicides are applied after the crop has emerged.

Herbicides are widely used in agriculture without their proper investigation of their side effects. This is of particular importance with legumes as herbicides not only affect the plant growth but soil symbiosis is also affected which ultimately leads to decrease in nodulation and nitrogen fixation. Reported reduction in nodulation in groundnut crop by herbicide treatment.[6,7]

Arachis hypogaea L. is the most legume oilseed, protein rich crop India. Even though India ranks first in area, its production is low compared to other groundnut growing countries. Among various reasons, nutrient supply and uptake by the plant decides the yield of groundnut. The groundnut is cash crop such screening of groundnut cultivars to acetic acid can be beneficial for obtaining the higher yield. This work was carried out to know the effect of acetic acid as pre-plant herbicide at different concentration on the groundnut to control weeds.

MATERIALS AND METHODS

Collection of sample

Ground nut (*Arachis hypogaea L.*) was obtained from Oil Seeds Research Station of Tamil Nadu Agricultural University located at Virudhachalam, Tamil Nadu, India. The healthy seeds were chosen and used for laboratory and Pot culture experiments.

The experiment was conducted in greenhouse shaded started from July to August 2014. The first factor was the concentration of acetic acid: control (acetic acid was replaced with water) 0%, 10% and 20% of acetic acid. The second factor was the time of the application: 4, 8, and 12 day before planting. Pots with the diameter of 25 cm were filled with sand. Before application performed calibration in sand by flushing water through the field capacity, in order to obtain the volume of water used.

These pots were watered every 4 days with 500 ml of water. The 10 and 20% acetic acid concentration were prepared by mixing 50 and 100 ml pure acetic acid in 500 of water respectively.

Each treatment was poured into the pots on the 12, 8, and 4 days to planting. Ten seeds of *Arachis hypogaea L.* were planted in each pot. Ten seeds of groundnut (*Arachis hypogaea L.*) were planted in each pot. The pots were maintained for the following treatment. Untreated: Control (0%), T_1-Acetic acid (10%) and T_2-Acetic acid (20%).

Morphometric Parameters

Observations were made at the age of 2 weeks after planting (wap), parameters measured were as follows:

$$\text{Germination percentage} = \frac{\text{Number of normal seedlings}}{\text{Number of seed germination}} \times 100\%$$

Height of the plant (in cm), Number of leaves (per cm), Shoot length (in cm), Root length (in cm), Number of roots (per plant) and Root nodules (per plant)

Isolation of Nodules from legume Plant was also done.[8]

Biochemical Constituents

Carbohydrate, Protein, Chlorophyll, Total chlorophyll, were also estimated.[9-11]

Plant Phytotoxicity

Plant phytotoxicity was observed visually by comparing the leaves color of the treated plants to the healthy one (control), which was expressed on a scale of 0-4.[12]

0 = No poison, 0-5% shape and color of young leaves are not normal

1 = Midly poisoned, > 5-20% shape and color of young leaves are not normal

2 = Moderately poisoned, > 20-50% shape and color of young leaves are not normal

3 = Severely poisoned, > 50-75% shape and color of young leaves are not normal

4 = Very severely poisoned, > 75% shape and color of young leaves are not normal, dry and fall off, the plant dies.

Phytochemical Analysis

Carotenoids, Riboflavin, Phenols, Tannins and Saponins were also analysed.[13-17]

Statistical Analysis

The results obtained in the present investigation were submerged to statistical analysis like mean (×) and standard deviation (SD).[18]

RESULTS AND DISCUSSION

In the present study was investigated from the cultivable land of Thulasenthirapuram soil, Thiruvarur Dt, Tamil Nadu, India. The competition between weed and *Arachis hypogaea L.* happened after the early growth. So that weed control could be done form beginning through the application of pre-plant herbicide.

After application of different concentration of acetic acid (T_1, T_2 and Control) at 4th, 8th and 12th days before planting. Result of present study suggested that acetic acid can be used as a pre-plant herbicide to improve metabolism of *Arachis hypogaea L.* for yield promotion and control weeds, quality improvement.

The raising of the pH in the treatment pots due to nature of acetic acid which is easily evaporated from the ground when the vapor reached the air and leaching, it will condensate to form water to normalize soil pH. One day after treatment the pH was 5.05. It was raised to 6.12 on planting. However the pH of the control was study on 7. Acetic acid is released into the soil will evaporate into the air and decompose naturally in the atmosphere by light.

Plant Height

4th, 8th, 12th day treatments of control pots plant height was showed better response. Over all pre-planting application was maximum in 10% acetic acid than 20% in plant height (Table 2).

Acetic acid treatment significantly influenced the leaf greenness and chlorophyll content, while the application of acetic acid as pre-planting treatment significantly affect *Arachis hypogaea L.* leaf area. 20% of acetic acid treatment resulted in the reduction of the leaf area, leaf greenness and chlorophyll content compared with the untreated control (Table 3).

Acetic acid was thought to inhibit the growth of the leaves. The application of acetic acid at 12th day before planting produced the widest leaf area, but not significantly different than the 8th day before planting treatment. Acetic aicd treatment in general inhibited the growth of leaves, while its pre-planting application was more obvious to reduce the spreading of leaf area at 4th day before planting (Table 2 and 3).

Root Growth

Acetic acid treatment during pre-planting did not inhibit the total root length, and root surface area. However, the rate of root growth was lower at 20% concentration and 4th day before planting. The presence of herbicides in the endosperm and sprout stem, resulted in limited glucose supply to support stem elongation.

It is through that poisoned roots utilized glucose at its own benefit (to grow more roots), while other part of the plant: especially stem will not be able to use it for its growth (elongation) (Table 1).

Root Length

4th, 8th, 12th day treatments of control pots root length was showed better response (Table-2). Over all pre-planting application was maximum in 10% acetic acid than 20%.

The total chlorophyll decreased in the concentration 20% of acetic acid. The total chlorophyll decrease at time of application 4 thdays before planting higher than the decline 8th and 12th day before planting. The total chlorophyll decrease was seen from slope value each the time of application sequentially from lowest value is 12th day before planting, 8th day before planting and 4th day before planting.

Plant Phytotoxicity

Phytotoxicity scoring was obtained from green leaves acetic acid treatment compared with controls. Pre-planting application of acetic acid showed mild poisoning on *Arachis hypogaea L*. 8, 921-8, 551% which will allow the plants to grow back to normal.

In our study was found that the efficacy of vinegar at 20% concentration resulted in significant damage to *Arachis hypogaea L*. At early phase, however, 28 days after the treatment the plant groundnut shown the damage and could provide maximum grain harvest.

Acetic acid treatment upto 20% as pre-plant application at 4th day before planting did not affect the seed germination. Since the seed viability, seed with germinated more that 80%.

Acetic acid is released into the soil will evaporate into the air and decompose naturally in the atmosphere by light.

Carotenoids, Riboflavin, Phenols, Tannins and Saponins were also estimated.

In this study also, there is an increase in Plant height and leaf number by the use of acetic acid. It increase in chlorophyll a and b contents increase photosynthetic activity. In my study, increase in chlorophyll a and b contents of the *Arachis hypogaea L.* contributes increase in leaf chlorophyll contents. Increased in the protein synthesis of the plants and this could have a direct consequence on the plant growth and photosynthesis.

In our reports were similar to the finding of Effect of Acetic acid as pre-plant herbicide on maize germination our study reports correlated to the results showed that acetic acid treatment did not significantly inhibit maize germination, nor inhibit root growth.[15] However, of the concentration at 10% and 20% inhibited the growth of shoot at the same level of inhibition. Pre-panting treatment generally does not inhibit the growth of shoot.

Our study coincide to10% acetic acid applied as pre-planting in wheat could control broadleaf weed. However, it's no study on acetic acid as pre-planting on maize germination Acetic acid treatment does not inhibit root growth, however the growth of plant height and leaf area maize. 10 and 20% acetic acid concentration caused similar growth inhibition of the shoot, while pre-plant applications are generally not inhibit the growth of shoot.[19]

Pre-planting application of acetic acid showed mild poisoning on maize, i.e., 9, 938-14, 555% which will allow the plants to grow back to normal. It found that the efficacy of vinegar at 10% concentration resulted in significant damage to wheat at early phase, however, 28 days after the treatment the plant barley shown the damage and could provide maximum grain harvest.

CONCLUSION

Thus the present work signifies the better performance of cultivar acetic acid. As the *Arachis hypogaea L*. is cash crop such screening of groundnut cultivars to acetic acid can be beneficial for obtaining the higher yield. Limited study was available for acetic acid as a pre-plant herbicide. The control of weeds using herbicides could be a good method as it will cut the costs, time, labor and control the weeds.

The ideal herbicides are expected to have not toxic to the plants, effective to control the weeds. Acetic acid in the soil provides a source of carbon for the decomposition process in CO_2. Ideal herbicides are not toxic to plant, effective to control the weeds, inexpensive and leave no negative impact to the environment.

Acetic acid is an ideal herbicide easily decomposable by microorganisms and shows potential of bioaccumulation. Further research is needed in order to evaluate the acid determination in the environment and various parts of the plant.

Table 1: Effect of acetic acid on morphological parameters in *Arachis hypogaea L.* (4th days)

Treatment	Plant height (cm)	Number of leaves/plant	Shoot length (cm)	Root length (cm)	Root nodules	Number of roots/plant
Concentration of Acetic acid						
Untreatment	28.000	27.021	26.033	29.020	29.284	28.400
10%acetic acid	22.174	22.855	19.134	21.185	20.340	23.192
20%acetic acid	21.000	20.123	18.220	20.320	19.384	21.790
Time of Treatment						
4th day before planting	28.479	27.432	27.495	26.474	26.596	25.379
8th day before planting	23.123	23.064	25.128	23.473	22.494	24.823
12th day before planting	21.874	18.756	21.374	20.465	21.984	21.820

Table 2: Effect of acetic acid on morphological parameters in *Arachis hypogaea L.* (8th days)

Treatment	Plant height (cm)	Number of leaves/plant	Shoot length (cm)	Root length (cm)	Root nodules	Number of roots/plant
Concentration of Acetic acid						
Untreatment	29.000	27.021	25.033	25.020	28.324	26.400
10% acetic acid	22.654	25.578	21.884	24.155	23.576	23.222
20% acetic acid	21.000	23.333	18.654	21.765	22.435	21.432
Time of Treatment						
4th day before planting	26.479	27.432	28.495	28.474	28.598	26.379
8th day before planting	24.533	25.022	26.148	25.233	24.657	25.873
12th day before planting	21.334	21.221	23.453	21.654	18.345	22.829

Table 3: Effect of acetic acid on morphological parameters in *Arachis hypogaea L.* (12th days)

Treatment	Plant height (cm)	Number of leaves/plant	Shoot length (cm)	Root length (cm)	Root nodules	Number of roots/plant
Concentration of Acetic acid						
Untreatment	27.219	25.543	26.974	29.231	28.624	28.530
10% acetic acid	22.980	22.675	19.432	21.543	22.876	23.332
20% acetic acid	21.546	20.876	18.654	20.897	21.435	21.432
Time of Treatment						
4th day before planting	25.769	26.212	27.654	26.980	27.988	25.765
8th day before planting	22.654	23.432	26.324	22.098	22.777	22.432
12th day before planting	19.356	17.786	21.765	20.321	17.611	20.982

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