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Influence of mulching, hydrogel and nutrient management on seed quality parameters of summer groundnut (*Arachis hypogaea* L.)

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Abstract
The results revealed that, combination of black polythene mulch + hydrogel @ 5.0 kg ha^{-1} + integrated nutrient management recorded highest germination percent (92.00%), shoot length (20.90 cm), root length (7.05 cm), mean seedling length (28.18 cm), mean seedling dry weight (70.98 mg), SVI-I (2614), SVI-II (6583), EC (322 µSppm^{-1}), TDH (0.688 at A_{480} nm), oil content (46.93%), protein content (31.18%) and less seed infection (10.00%).

Keywords: Triclosan, TCS, determination, detection, sensor

Introduction

Groundnut (*Arachis hypogaea* L.) is an important edible oil and food of the world. It was introduced to India in 18th century. It is an annual and highly self pollinated crop belongs to the family *leguminaceae* and sub family *papilionaceae*. It consists of 26-28 per cent protein, 20 per cent carbohydrates, excellent amount of dietary fibers and 48-50 per cent oil, out of the 20 necessary minerals for normal body, seven are present in groundnut. Out of 13 vitamins which are necessary for normal body growth, nearly half are present in groundnut. Resveratrol is a phytochemical that reduces cardiovascular diseases and cancer growth.

Mulch is a layer of material applied to the surface of an area of soil. Its purpose is to conserve moisture, to improve the fertility and health of the soil, to reduce weed growth and to enhance the visual appeal of the area. Mulch forms a layer between soil and the atmosphere which prevents sunlight from reaching the soil surface, thus reducing evaporation. However mulch can also prevent water from reaching the soil by absorbing or blocking water from light rains. Biodegradable mulches are desirable because they can reduce non-recyclable waste, conserve resources and decreases environmental pollution. Similarly, the Indian Agricultural Research Institute (IARI), New Delhi has invented a hydrogel, which are cross-linked polyacrylamide polymers (PMA), these are semi-synthetic super absorbent and biodegradable polymers which absorb water from atmoshape and when moisture content was more in soil at later stage and releases it into soil when moisture drops. They are made up of water-insoluble acrylamide and potassium acrylate. Polymers are long parallel chains of molecules, and when cross linked they can create a network of polymeric chains. Approximately, hydrogel can absorbs up to 300 to 500 times their weight in water and when their surroundings begin to dry out, the hydrogels gradually dispense up to 95 per cent of their stored water. When they are exposed to water again, they will rehydrate and repeat the process of storing water.This process can last up to seven years when the biodegradable hydrogels decompose. The hydrogel attaches itself to the roots and sheds water during water deficit conditions and nourishes the crop. The gel due to its sticky nature binds to fertilizers and reduces fertilizer leaching. It also extends the irrigation duration from once in 4 days to once in 8 days. Considering nutrient aspects, it is a unpredictable legume it absorbs more nutrients if application of excess amount of N and K vegetative part grows vigorously and stats to lodging. So nutrient management is also a important parameter in this crop (Singh *et al.*, 2011) [12].

Considering these issues going to evaluate the "Influence of mulching, hydrogel and nutrient management on seed quality parameters of summer groundnut (*Arachis hypogaea* L.)" with focusing on the importance of soil moisture and ways to enhance it and to produce sustainable yields and better seed quality. a study was conducted to generate information on the aspects. The investigations were carried out entitled.

Material and methods

A experiment was carried out in AICRP on Groundnut, Chintamani with test crop groundnut var. KCG-6 in simple completely randomized design with 18 treatment combinations. The treatment combinations were T_1- Black polythene mulch (7 micron) + no hydrogel + organic management, T_2- Black polythene mulch (7 micron) + no hydrogel + inorganic management, T_3- Black polythene mulch (7 micron) + no hydrogel + integrated management, T_4- Black polythene mulch (7 micron) + hydrogel (2.5 kg/ha) + organic management, T_5- Black polythene mulch (7 micron) + hydrogel (2.5kg/ha) + inorganic management, T_6- Black polythene mulch (7 micron) + hydrogel (2.5 kg/ha) + integrated management, T_7 - Black polythene mulch (7 micron) + hydrogel (5.0 kg/ha) + organic management, T_8 - Black polythene mulch (7 micron) + hydrogel (5.0 kg/ha), inorganic management, T_9 -Black polythene mulch (7 micron) + hydrogel (5.0 kg/ha) + integrated management, T_{10} - No mulch + no hydrogel + organic management, T_{11} - No mulch + no hydrogel + inorganic management, T_{12} - No mulch + no hydrogel + integrated management, T_{13} - No mulch + hydrogel (2.5 kg/ha) + organic management, T_{14} - No mulch + hydrogel (2.5 kg/ha) + inorganic management, T_{15} - No mulch + hydrogel (2.5 kg/ha) + integrated management, T_{16} - No mulch + hydrogel (5.0 kg/ha) + organic management, T_{17} - No mulch + hydrogel (5.0 kg/ha) + inorganic management, T_{18} - No mulch + hydrogel (5.0 kg/ha) + integrated management.

The moisture content of seeds was determined by gravimetric method by using high constant temperature oven method as per the ISTA (2012) [10]. Five grams of seeds was taken randomly from each treatment in two replications were ground by using mixer and taken in alluminium boxes and dried in the oven at 130 ± 2°C for 1 hour. After oven drying the metal boxes along with ground material were cooled in desiccators over silica gel for thirty minutes.Then the samples were weighed and the seed moisture content was calculated and expressed in percentage on wet weight basis by using formula.

$$\text{Moisture content (\%)} = \frac{\text{M2} - \text{M3}}{\text{M2} - \text{M1}} X100$$

Where,

M_1- The weight of the container and its lid

M_2-The weight of the container, its lid and contents before drying

M_3- The weight of the container, lid and contents after drying.

The germination test was conducted in the laboratory by using "between paper" method as per ISTA rules (2012) [10]. One hundred seeds of four replications were placed equidistantly on moist germination paper. The rolled towels were incubated in walking germinator and maintained at temperature of 25 ± 1°C with 90 per cent relative humidity. The germinated seedlings were evaluated on 5th and 10th day as first and final count, respectively and the percentage of germination was expressed based on the normal seedlings present in the test.

From the standard germination test, ten normal seedlings from each treatment in four replications were randomly selected on the day of final count. The length of shoot was measured from collar region to the tip of shoot of the seedling and expressed in centimeters.

From the standard germination test, ten normal seedlings from each treatment in four replications were randomly selected on the day of final count. The length of root was measured from collar region to tip of the primary root of the seedling and expressed in centimeters.

Ten normal seedlings in each replication were randomly selected at final count of the germination test and the length was measured from the tip of the primary root to the point of attachment of cotyledons. The mean of ten seedling length was expressed in centimeters.

The seedlings used for measuring the seedling length after removing cotyledons were dried in hot air oven at 80 ^{0} ± 1 ^{0}C for 24 hours and mean seedling dry weight was expressed in milligrams.

From the seeds kept for laboratory germination test, under between paper method. The germinated seedlings were evaluated on 5th and 10th day as first and final count, respectively and the percentage of germination was expressed based on the normal seedlings present in the test. Then from that ten normal and healthy seedlings from each replication were selected randomly on 10th day and seedling length (shoot and root) was measured in centimeters and mean shoot and root length.

Seedling vigor index-I was recorded by multiplying standard germination percentage and mean seedling length. It was computed by adopting the formula as suggested by Abdul Baki and Anderson (1973) and expressed as whole number.

SVI-I = Germination (%) × Mean seedling length (cm).

From the seeds kept for laboratory germination test, under between paper method. The germinated seedlings were evaluated on 5th and 10th day as first and final count, respectively and the percentage of germination was expressed based on the normal seedlings present in the test Then from that ten normal and healthy seedlings from each replication were selected and those seedlings were dried in hot air oven maintained at 80 ± 2 ^{0}C for 24 hours and cooled in desiccator.The mean seedling dry weight was recorded and expressed in mg per seedling.

Seedling vigour index-II was evolved by multiplying standard germination percentage and seedling dry weight.It was calculated by adopting the formula as suggested by Abdul Baki and Anderson (1973) and expressed in whole number.

SVI-II= Germination (%) × Mean seedling dry weight (mg).

Twenty five seeds of two replications were taken randomly from each treatment in a beaker. Then the seeds were soaked in 25 ml of distilled water for 24 h at 25±10 °C. The steeped water from soaked seeds was collected and the electrical conductivity (EC) of seed leachate was measured in digital conductivity meter (Model: Systronic conductivity meter 306). After subtracting the EC of the distilled water from the value obtained from the seed leachate, the actual EC due to electrolyte was measured and expressed in µS ppm^{-1} (Anon., 2007).

The total dehydrogenase activity was determined by method described by Perl (1978) with slight modifications. The seeds selected for estimating the EC value were used to determine the total dehydrogenase activity. Seed coat of these imbibed seeds were carefully removed and then soaked in 0.5 per cent tetrazolium solution at 30 ± 1 ºC for a period of 24 hours. Then they were washed thoroughly with distilled water. The red colour (Formazan) was diluted from the stained embryos by soaking in 5ml of 2-methoxyethanol (methyl cellosolve) for 24 hours in an airtight screw capped vials. The extract was decanted and the colour intensity was measured with the help of spectrophotometer (Model-Systronics UV-VIS spectrophotometer 1l7) OD value at 480 nm. The dehydrogenase activity was expressed in terms of optical density at 480 nm.

Near-infrared spectroscopy (NIRS) is a spectroscopic method that uses the near infrared region of the electromagnetic spectrum (from about 700 nm to 2500 nm)and has vast applications in agriculture.

Principle: At one end of this spectrum are the high energy waves such as x-rays and ultraviolet, while at the other end of the spectrum are the low energy waves such as infra-red, micro waves and radio waves. The color of seed in the visible spectrum gives us information on a variety of oils, protein and amino acids and their respective percentages in the seed.

Working: The section (acts as a feeder) of seed is fed and used as a reference, and this is filled fully for the protein content (%) to be estimated. Whereas, oil content (%) estimation only one seed has to be placed in the section. NIR notices the color of seed in the visible spectrum and gives us the information on protein and oil (%). Since it is connected to the computer, the results which are analysed can be getting on the computer screen.

Spectroscopy is rapid, timely, less expensive, non-destructive, straight forward and more accurate than conventional analysis

Detection and identification of seed mycoflora was done by blotter paper method (TP) as per ISTA (2012) Twenty five seeds each from four replications were placed equidistance. One seed at centre, second circle with eight seeds and third circle with sixteen seeds to make twenty five seeds in sterile glass petridishes of 15 cm diameter containing 2 moist blotter paper (Whats man No.1). Then the petridishes were incubated in walking germinator at 20 ^{0}C for seven days with 12 hours light and 12 hours dark cycles in walk in germinator at Department of Seed Science and Technology. After incubation, seeds were examined under steriobinocular microscope for the presence of infection. The seeds were infected by *Rhizophus, Aspergillus* and *Penicillium spp.* and expressed as percentage of total infection.

Results and discussion

The seed germination percentage significantly influenced by the mulching, hydrogel and nutrient management in summer ground nut, among the treatments T_9 recorded highest (93.00%), was followed by T_8 (92.00%) whereas the lowest of (79.00%) was noticed in T_{10} treatment. Higher seed germination (%) may be attributed to better growth and development of the seeds promoted by mulching, hydrogel and nutrient management. The results are in accordance with Shakunthala *et al*. (2010) and Singh *et al.* (2013) [13] and depicted in table 1.

The similar trend was observed with respective to shoot length, root length, mean seedling length, mean seedling dry weight which was recorded maximum in T_9 (20.90 cm, 7.05 cm, 28.18 cm, 70.98 mg respectively), was on par with T_8 (20.55 cm, 6.95 cm, 27.71 cm, 70.24 mg respectively), whereas the lowest (11.93 cm, 4.05 cm, 16.13 cm, 54.20 mg) was recorded in T_{10}. Improvement in seed germination and seedling growth is due to synergistic effect of black polythene mulch, hydrogel at 5 kg ha^{-1} and integrated nutrient management is ascribed to continuous supply of nitrogen and phosphorous to produce healthy seed Singh *et al*. (2013) [13] and depicted in table 1.

The similar trend was observed with respective to SVI-I and II which was recorded maximum in T_9 (2614 and 6583 respectively), was on par with T_8 (2542 and 6445 respectively), whereas, the lowest (1270 and 4268 respectively) was recorded in T_{10}. Seedling vigour index is a function of germination (%) and seedling length. Improvement in these attributes is mainly due to improved quality parameters of seed bought about by cumulative effect of black polythene mulch, hydrogel at 5 kg ha^{-1} and integrated nutrient management Singh *et al*. (2013) [13] and depicted in table 2.

The lowest EC and highest TDH (322 µS ppm^{-1} and 0.688), followed by T_8 (360 µS ppm^{-1} and 0.685), whereas highest EC and lowest TDH was recorded in T_{10} (525 µS ppm^{-1} and 0.587 µS ppm^{-1}). Because of high quality seed development and maintenance of membrane integrity, electrical conductivity value was also lower and TDH value was found to be high with the treatment combination black polythene mulch, hydrogel at 5 kg ha^{-1} and integrated nutrient management Shakunthala *et al.* (2010) and depicted in table 2.

Highest oil and protein content (%) was recorded in T9 (46.9 and 31.2 respectively), was followed by T8 (46.5 and 30.2 respectively), whereas lowest was recorded in T10 (40.7 and 25.4 respectively). Better CO2 production and greater exchange of nutrients that enhanced the mobility of nutrients under this treatment led to favourable environment in the plant system and thereby increased oil content of groundnut. Probable reason for increase in protein is that the nitrogen is an integral part of protein and phosphorus is an integral part of certain co-enzyme involved in protein synthesis. The increase in protein synthesis in groundnut is mainly due to cumulative

Table 1: Influence of mulching, hydrogel and nutrient management on Seed moisture content (%), Germination (%), Shoot length (cm), Root length (cm), Mean seedling length (cm) and Mean seedling dry weight (mg) of summer groundnut.

Treatments	SMC (%)	Germination (%)	Shoot length (cm)	Root length (cm)	MSL (cm)	MSDW (mg)
T_1	8.2	86.30	17.00	5.95	23.49	65.63
T_2	8.1	86.50	17.40	5.98	23.61	65.72
T_3	8.2	86.80	17.78	6.48	24.41	66.61
T_4	8.2	88.80	19.20	6.50	26.34	66.91
T_5	8.1	89.00	19.78	6.63	26.53	68.35
T_6	8.2	89.30	19.80	6.80	26.82	68.66
T_7	8.1	91.50	20.53	6.90	27.63	69.65
T_8	8.2	91.80	20.55	6.95	27.71	70.24
T_9	8.1	92.80	20.90	7.05	28.18	70.98
T_{10}	8.2	78.80	11.93	4.05	16.13	54.20
T_{11}	8.1	79.00	12.00	4.10	16.40	54.61
T_{12}	8.2	79.30	12.15	4.15	16.56	55.38
T_{13}	8.2	81.30	12.83	4.45	17.53	56.30
T_{14}	8.1	81.50	12.98	4.50	17.70	56.79
T_{15}	8.2	81.80	13.53	4.65	18.50	57.69
T_{16}	8.1	84.50	14.38	4.90	19.60	59.35

T_{17}	8.2	84.80	14.63	4.98	19.92	59.74
T_{18}	8.1	85.00	15.15	5.15	20.60	60.44
SEm±	0.05	1.29	0.29	0.07	0.31	0.37
CD(P=0.05)	0.13	3.66	0.82	0.20	0.88	1.07

Table 2: Influence of mulching, hydrogel and nutrient management on Seedling vigour index- I and II, Electric conductivity (µS ppm^{-1}), Total dehydrogenase activity (A_{480} nm), Oil content (%), Protein content (%) and Seed infection (%) of summer groundnut.

Treatments	SVI-I	SVI-II	EC (µS ppm^{-1})	TDH (A_{480}nm)	Oil content (%)	Protein content (%)	Seed infection (%)
T_1	2026	5660	412	0.647	43.9	28.3	33.5
T_2	2042	5685	407	0.653	44.1	28.4	23.5
T_3	2117	5779	397	0.657	44.3	28.6	22.5
T_4	2337	5942	382	0.661	44.4	28.8	21.0
T_5	2361	6083	380	0.668	44.7	29.1	19.5
T_6	2397	6128	367	0.673	44.9	29.3	18.0
T_7	2528	6373	362	0.679	45.8	29.8	14.0
T_8	2542	6445	360	0.685	46.5	30.2	13.5
T_9	2614	6583	322	0.688	46.9	31.2	10.0
T_{10}	1270	4268	525	0.587	40.7	25.4	62.5
T_{11}	1296	4314	511	0.588	42.2	25.9	54.0
T_{12}	1313	4386	495	0.597	42.3	26.4	51.0
T_{13}	1424	4575	482	0.602	42.4	26.5	50.0
T_{14}	1443	4629	466	0.611	42.6	26.9	48.5
T_{15}	1512	4715	457	0.615	42.9	27.4	43.5
T_{16}	1656	5016	435	0.629	43.3	27.8	41.0
T_{17}	1688	5064	424	0.638	43.5	28.0	39.5
T_{18}	1751	5137	415	0.643	43.9	28.1	35.5
SEm±	42.56	87.28	16.45	0.004	0.343	0.309	1.143
CD(P=0.05)	120.66	247.48	46.64	0.012	0.974	0.876	3.240

Effect of pod yield Bajarang *et al*. (2013) and depicted in table 2.

Lowest seed infection (%) was recorded in T_9 (10.00), followed by T_8 (13.5) and highest was recorded in T_{10} (62.5). This may be attributed by good soil mycoflora and beneficial microorganisms, which in turn results in high soil temperature and because of high soil temperature infection foci will be less in case of the seeds with black polythene mulch, hydrogel 5 kg ha^{-1} and integrated nutrient management Ebrahim *et al*. (2014) [9] and depicted in table 2.

The studies could be concluded that combined effect of black polythene mulch + hydrogel at 5 kg/ha + integrated nutrient management gave better seed quality parameters over other treatments.

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