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Weed invasion of groundnut crop in sandy soil using drip irrigation system with black polyethylene mulch

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ABSTRACT

Weeds cause serious damage to the crop yield by sharing land, water, soil nutrients, and sunlight, etc., which increase the cost of cultivation, impairment of quantity and quality. The objective of the research is to compare the water use efficiency, weed index, and weed control efficiency under a drip irrigation system with black polyethylene mulch, using four treatments, such as Drip, Drip with Mulch, Mulch, and Control. The acquired findings revealed that there is a significant difference between the treatment means, with the least significant difference being (P>0.05). However, the maximum acquired water use efficiency in drip with mulch treatment is 14.43 kg/ha-mm, followed by drip, mulch, and control were 10.89, 8.82, 6.55 kg/ha-mm, respectively. Due to increasing weed infestation, the weed index in control was found to be high as 33.69 percent, followed by mulch, drip and drip with mulch were 28.79, 12.81 and zero per cent duly. The weed control efficiency was acquired to be high in drip with mulch treatment as 91.34 percent and 84.78 percent at 30 and 60 days after sowing respectively. Plastic mulch improves the water use efficiency and productivity with a controlled amount of water application with drip irrigation system. The research concludes that using a drip irrigation system in conjunction with black polyethylene mulch for the cultivation of groundnut crops in sandy soils is superior and beneficial for the farmers to achieve high yields, which results in economic benefit of the farmers.

Key words : *Black polyethylene mulch, Drip irrigation system, Groundnut, Water use efficiency, Weedindex and Weed control efficiency.*

Introduction

The groundnut (*Arachis hypogaea,* L.) is a major oilseed crop, which ranks 13th among the edible oil crops in the world, and accounts for 40 per cent of the total national oilseed production (Sathya Priya *et al.*, 2013). The Indian agricultural statistics at a glance 2018 reported that the groundnut produces 9.18 million tonnes annually in 4.91 million ha with average productivity of 1868 kg/ha. In Andhra Pradesh, it produces 1.04 million tonnes annually in 0.74 million ha with average productivity of 1416 kg/ha. India is the world's largest country in terms of both area and production of groundnut. Andhra Pradesh is the 3rd largest producer of groundnut after Rajasthan and Gujarat. It's primarily grown in the Rayalaseema districts of Anantapur, Cuddapah, Kurnool, and Chittoor, as well as the coastal areas of Andhra Pradesh.

Weeds are one of the most limiting elements in the groundnut crop. Weeds are described as an unwanted wild plant that grows in an unwanted loca-

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tion and compete with cultivated plants, resulting in crop production losses that are estimated to range between 30 to 50 percent based on weed infestation (Pandey *et al.,* 2001). Weed-related groundnut yield losses have been reported as 24 to 70 percent (Jhala *et al.,* 2005). Weed infestation causes crop losses ranging from 74 to 92 percent, according to (Kabita, 2020). Weeds are responsible for 45 to 71 percent of groundnut output loss, according to (Yogita *et al.,* 2018). Groundnut yield losses due to high weed infestation range from 13 to 80 percent in India, according to reports (Ghosh *et al.,* 2000). A detailed study was undertaken from 2006 to 2008 at 10 distinct locations under AICRPG i.e., Jalgaon, Ratnagiri, Khargone, Chinthamani, Virddhachalam, Kadiri, Jagtial, Dharwad, Durgapura, and Junagadh have reported yield losses of 69, 45, 59, 58, 74, 77, 64, 31, 52, 57 percent (AICRPG report, 2009).

Weeds are developing rapidly as a result of the application of farmyard manure and nutrient fertilizers to the plants; if weeding activities are not undertaken at important phases in the groundnut crop, yields will be reduced, and in some cases, entire crop failure will occur. Many weed control strategies have been developed to control weeds in the field, including the application of chemical fertilizers to the soil during tillage operations and the use of pre and post herbicide applications to kill undesired plants.Preventive cultural approaches such as weed control by using mechanical machines or hand-held tools, and pesticides are available, however, the most effective method is usually a combination of these above tactics, (Anderson, 2007).

Weeding can also be controlled through the use of organic and inorganic mulches. The inorganic mulch benefits the environment by increasing soil moisture, reducing soil erosion, maintaining soil temperature, and improving soil structure, fertility, and biological regime. Apart from that, a farmer can save the extra money spent on the weeding operation (Dalorima*et al.,* 2014). Mulches are utilized to improve the soil temperature because energy from the sun's rays transmits into the mulch and immediately heats the air and soil underneath it, which is retained by the greenhouse effect. The black plastic mulch enhances soil temperature and enhances efficiency by improving the conditions for transmitting heat from mulch to soil reported by (Lalitha *et al.,* 2010). Weeds are effectively controlled under black plastic mulch by allowing heat sun's rays, inside the soil to killing pathogens, fungi and also preventing weed seeds from germination. In groundnut, the polythene mulch plots yielded 94.5 percent more than the without mulch plots reported by (Ramakrishna *et al.,* 2006). According to the researchers, translucent plastic mulch had the most weed infestation while black polyethylene mulch had the least (Ashrafuzzaman *et al.,* 2011).

Inadequate water delivery throughout critical periods of plant growth is to be the primary cause of low groundnut yield in India, reported by (Narayanamoorthy *et al.,* 2020). Drip irrigation is the efficient way to provide water and fertigation to crops, with an efficiency of 90 to 95 percent. It eliminates overwatering, which results in fewer weeds growth, and saves money by delivering water and nutrients straight to the plant's roots zone in the proper amounts, at the appropriate time. The major goal of this study is to compare water use efficiency, weed index, and weed control efficiency for groundnut crop in sandy soil under a drip irrigation system with black plastic mulch at 30 and 60 days after sowing.

Materials and Methods

The present study was consummated at Field Irrigation Laboratory, Dr. NTR College of Agricultural Engineering, Bapatla, Andhra Pradesh, during *rabi* season. Geographically the experimental site is located at a longitude of 88° E and latitude of 16°N with 5 m MSL altitude. Bapatla is located in the Southeastern part of the Guntur district of Andhra Pradesh. It is very close to the coast, the town experiences environments of hot in summers and cool in winters. The minimum temperature and maximum temperature ranges between 18 to 25 °C in winter and 40 to 48 °C in summer. The relative humidity ranges from 60 to 75 per cent. The precipitation is very high and receives an annual rainfall of about 700 to 1150 mm with an average of 940 mm.

The type of soil is sandy loam in nature and the source of irrigation is tube well. The groundnut variety of TAG-24 was selected with a crop period of 120 days. The sowing was done with row spacing 60 cm and plant spacing of 30 cm with a drip irrigation system. The experiment is conducted with an area of 360 m^2 is divided into four equal treatments namely Drip, Drip with Mulch, Mulch, and Control, having an equal area of 90 m^2 with 15 m x 6 m each plot size. The parameters like water use efficiency, weed index and weed control efficiency are studied dur-

ing the experiment under a drip irrigation system with a 25-micron thickness of black polyethylene mulch was selected based on the previous researchers. The weed control efficiency was estimated at 30 and 60 days after sowing of groundnut crop. The following methodology and formulas are used to compare the weed parameters.

The crop water requirement for groundnut crop was calculated by using CROPWAT 8.0 Software i.e., 449 mm by considering crop, soil, evapotranspiration data were obtained from the agriculture college farm and also considering meteorological weather data like average minimum and maximum air temperature in °C, average relative humidity in per cent, Sunshine hours, total rainfall in mm, wind speed in m/s, were obtained from agricultural observatory station, Bapatla for the period 10 years from 2008-2018.

Water use efficiency (WUE)

The water use efficiency is defined as the ratio of total yield obtained to that of the amount of water used. For calculating the water use efficiency, the yield obtained from each experimental site and the amount of water used for each site was recorded. The water use efficiency was calculated according to Abdelraouf (2014) and is expressed in units as kg/ha-mm.

$$WUE = \frac{\text{Yield (kg/ha)}}{\text{Amount of water (mm)}}$$

Weed index (WI)

Weed index is the ratio of yield in maximum weed-free treatment minus yield in the control treatment to the yield in maximum weed-free treatment and is expressed in percent. The following mathematical formula was used to estimate the weed index reported by (Gill and Vijayakumar, 1969).

$$WI = \frac{\text{Yield in maximum weed free plot - Yield in plot under treatment}}{\text{Yield in maximum weed free plot}}$$

Weed control efficiency (WCE)

Weed control efficiency is the ratio of the weight of dry weed in the control plot minus the weight of dry weed in a treated plot to the weight of dry weed in the control plot. The following mathematical formula was used to estimate the weed control efficiency according to (Mani *et al.*, 1973) and expressed in percent.

$$WCE = \frac{(WDC - WDT)}{WDC} \times 100$$

Where,

WDC= weight of dry weeds in the control plot and

WDT= weight of dry weeds in the treated plot.

The statistical analysis was analysed by using RBD Design with Duncan multiple range tests (DMRT) by using the SAS 9.3 software. The parameters of treatment means were compared with the least significant difference. The observation data were analyzed with a 5 per cent(p=0.05) level of significance. In the present study, four treatments are selected with the three replications for Water use efficiency, weed index, weed control efficiency.

Results

The research work was conducted to study the weed infestation parameters, which are affecting the yield losses under drip irrigation with black polyethylene mulch, the collected data from the study were tabulated and calculated using conventional techniques. The analyzed results were summarized and presented.

Water use efficiency (WUE)

From the graphical representation Fig.1. the water use efficiency is high as 14.43 kg/ha - mm was depicted in drip with mulch treatment becauseefficient use of application of irrigation water under drip system in addition to that a moisture conservation through black polyethylene mulch leads to record the higher yields. The water use efficiency for drip, mulch, and control are 10.89, 8.82, 6.55 kg/ha^{-1}-mm^{-1} respectively.

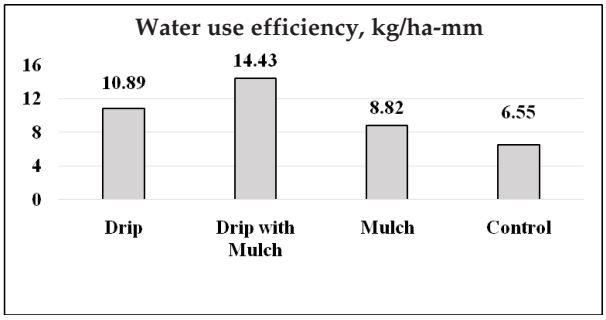

Fig. 1. Comparison of water use efficiency with Drip with Mulch treatment

Weed index (WI)

From thegraphical representation Fig.2. comparison of weed index was done by drip with mulch which is considered as weed-free treatment generally which is taken as zero percent, the decreasing of yield is due to the presence of higher weeds in control as 33.69 per cent followed by mulch and drip is 28.79 per cent and 12.81 per cent.

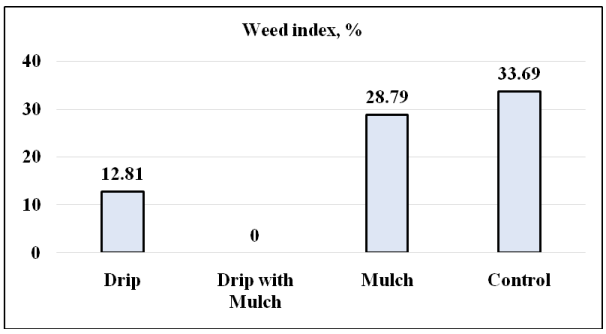

Fig. 2. Comparison of weed index with Drip with Mulch treatment

Weed control efficiency (WCE)

From the graphical representation Fig.3. it is clear that the weed control efficiency is compared as to how best the treatment plots control the weed infestation with control. The weed control efficiency was reported maximum in drip with mulch treatment at 30 and 60 days after sowingwas 91.34 and 84.78 per cent. The high weed control efficiency is obtained due to the efficient use of black plastic mulch installation in combination with a drip irrigation system. (Bhetariya *et al.,* 2016) reported weed control was found more than 90 per cent weed control efficiency in drip with black plastic mulch. Theweed control efficiency was found low in drip irrigation as 56.63 and 47.11 per cent for 30 and 60 days after sowing respectively.

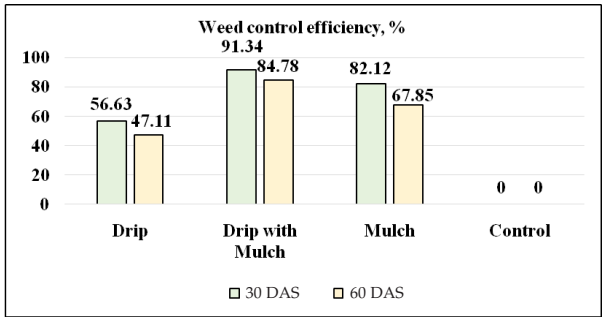

Fig. 3. Comparison of weed control efficiency with control treatment

Discussion

Thewater use efficiency (Haibing He *et al.,* 2013) was reported plastic mulch improves the water use efficiency and productivity with a controlled amount of water application with drip irrigation system, in the congruous way the present study was reported highest water use efficiency in drip with mulch treatment. From the statistical analysis, the treatment means of water use efficiency shows, there is a significant difference among the treatment means with the least significant difference (LSD) is 0.989 with 5 per cent (P>0.05) level of significance and the standard error mean is SEm ± 0.29, the coefficient of variation among the treatments means is 4.89 per cent.

The obtained results of weed index are resembling trend were followed by (Gill and Vijay Kumar, 2006) was reported the highest weed index of 58.20 percent was obtained in un-weeded control while the lowest of zero percent was obtained in weed-free treatment. From the statistical analysis, the treatment means of weed index shows, there is a significant difference among the treatment means with the least significant difference (LSD) of 0.8595 with a 5 per cent (P>0.05) level of significance and the standard error mean is SEm ± 0.74, the coefficient of variation among the treatment means is 6.82 per cent.

The black polyethylene mulch treatment was reported weed control efficiency between drip with mulch and drip. The Weed control reduces water requirement, nutrients need which results in lower production costs for the farmers. The weed control efficiency for 30 and 60 days after sowig shows that there is a significant difference among the treatment means with the least significant difference (LSD) is 0.7808 with 5 per cent (P>0.05) and (LSD) is 0.8855 with 5 per cent (P>0.05) level of significant and the standard error mean is SEm ± 1.38 and SEm ± 1.48,the coefficient of variation among the treatments is 4.15 and 5.15 per cent for 30 and 60days after sowing weeding operations.

Conclusion

From the above research work, it was concluded that the results of higher water use efficiency are reported as 14.43 kg/ha-mm in drip with mulch treatment. The weed index was acquired high in control at 33.69 per cent due to higher weed infesta-

tion. The obtained results of weed control efficiency were compared with control and the weed control efficiency is observed high in drip with mulch as 91.34 and 84.78 per cent at 30 and 60 days after sowing duly. The conclusion of the study renewals that the use of drip irrigation system along with the polyethylene mulch for the cultivation of groundnut crop in sandy soils is superior and beneficial for the farmer to get the high yields which result in economic benefit and also besides a farmer can save the extra amount spent for the cost of weeding operation. It can be suggested that further research should be carried out along the following line of areas i.e., different types of color plastic mulches are used for investigation purposes, other crops should also be researched on plastic mulches anddifferent thickness of plastic mulches under groundnut crop.

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Conflict of Interest

The authors have declared that no conflict of interests exist.

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