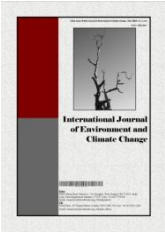

International Journal of Environment and Climate Change

12(9): 151-156, 2022; Article no.IJECC.80950
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Impact of Ridge and Furrow Method of Planting on Groundnut Yield Attributes in Chittoor District of Andhra Pradesh, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2022/v12i930749

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/80950

Original Research Article

Received 09 November 2021
Accepted 10 January 2022
Published 18 April 2022

ABSTRACT

Climate change is putting increasing pressure on India's farmers' land and natural resources, which they rely on not just to feed the country but also to support their livelihoods. Approximately 30% of land is currently degraded, and rising temperatures mean agriculture will require 30% more water. Innovative approaches are emerging across India to assist farmers in adapting to climate change challenges and mitigating the effects of their farming practises. An innovative ridge and furrow planting pattern and its impact on ground nut crop production was carried out. The field experiment was conducted during the two consecutive Rabi and Kharif seasons of 2020 and 2021 to study ridge and furrow in-situ conservation system for Groundnut crop at farmer's fields in Chittoor district of Andhra Pradesh under Southern agro-climatic region. Raised bed planting involves sowing of crops using raised bed maker alternated with furrows for irrigation. Bed width depends upon crop spacing usually ranging from 30 cm, and accommodates crop on raised bed. Raised beds require reshaping each year preferably before Kharif season. Bed planting reduces cost, and saves seed, fertilizer and irrigation water. It also increases water-use efficiency both under rainfed and irrigated scenarios because water moves laterally from furrows into beds thereby reducing evaporation losses. Further lesser incidence of pest and diseases as well as better aeration within furrows. Weed population reduced on ridge and furrow method of planting. The ridge-furrow method of planting groundnut has been reported to save seed and water by 25-30% and fertilizer by 25%, yield enhancement to the extent of 8-23% higher compared to the normal flatbed sowing method. Economic analysis revealed that the net profit was recorded higher under

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ridge and furrow system compared to normal flatbed sowing. Benefit–cost *ratio* (BCR) ratio was recorded under ridge and furrow system (5.13) while under flat sowing system (2.20) for the consecutive years respectively.

Keywords: Climate change; ridge-furrow; groundnut.

1. INTRODUCTION

The groundnut, often known as the peanut or monkey nut, is a South American legume. In the 1500s, colonial Portuguese influence stretched to Brazil, southern Bolivia, and then northwestern India. The plant was introduced to Africa by the Portuguese, from where it spread to North America. During the first half of the 16th century, India obtained the crop from one of the Pacific islands near China, where it had been introduced previously from either Central or South America. The groundnut is called the 'king of oilseeds' due to its high oil content. It is also known as the 'wonder nut' or the 'poor man's cashew nut'. "Groundnut is an important oilseed crop grown in India. Globally India ranks first in area and second in production. India, accounts for 31 % of the total groundnut area in the world with 26.4 Mha with a total production of 37.1 million MT. The average productivity is 1400 kg/ha. The annual global export of groundnuts is of two million MT valued at 2,600 million US $." (Source: Indian Oilseeds and Produce Export Promotion Council [1]). "Groundnut crop in India are mainly grown in certain states like Gujarat, Andhra Pradesh, Tamil Nadu Karnataka and Maharashtra. The state of Andhra Pradesh has about one-third of the acreage of groundnut crop is cultivated in an area of 6.66 lakh ha in India and is in the third in position by contributing 17 per cent of the whole production. Total ground nut production in India accounts for 9.18 MT and Andhra Pradesh accounts for 1.04 MT" (Source: Apeda.gov.in, 2018). "The productivity of ground nut stands at 883 kg/ha for Andhra Pradesh. The irrigated area of groundnuts in the state has risen from 12.4 lakhs hectares in 1955-56 to 17.66 lakh hectares in 2018-19 and the production has increased from 10.7 lakh tons in 1955-56 to 104 lakh tons in 2018-19" (Source: Season and crop report of A.P. [2]).

"In Andhra Pradesh it is mainly cultivated in Rayalaseema districts viz., Anantapur, Cuddapah, Kurnool, Chittoor districts and some mandals of Nellore district. Anantapur district ranks first in Andhra Pradesh in terms of area of acreage at 7.64 lakh ha followed by Chittoor district accounts 1, 89, 000 hectares and production of groundnut crops at Anantapur 7.5 lakh tones and Chittoor district stands at 1, 31,000 tons while the productivity levels of groundnut crop in Anantapur district stood at 992 Kg per ha the district was 2696 kg per hectare" (source: Season and crop report of AP [2]). "The average annual rainfall in Chittoor district assured 848 mm per annum. The rainfed agriculture suffers from a number of hydro physical and socio-economic constraints, which affect the productivity of rainy and post-rainy season crops. These include erratic and undependable rainfall, excess and deficient moisture with in a season, harsh thermal regime, soil loss, low level of input use and technology adoption and resource poor farmers" [3]. Groundnut is a major oilseed crop grown during the South-East monsoon season in the rain fed areas of Southern India. The Plane-land cultivation system is popular in various Agro-climatic zones of Andhra Pradesh state. The crop experiences moisture stress during the dry spell ranging from 15 to 21 days at any growth stage under rainfed conditions, resulting significant reduction in the yield and excess rainfall leads to prevalence of a range of pests and diseases. Currently, for large cultivation of Kharif crops such as groundnut, which suffers from water logging and poor aeration, lowering crop production. Any soil moisture deficiency during the early stages of pod establishment is extremely sensitive, resulting in lower pod weight. When rains fail during the monsoon season, rain-fed groundnut crops are frequently subjected to soil moisture stress. Excessive and prolonged rains can cause poor drainage and aeration, resulting in plant nutrient non-availability and low microbial activity. Ram et al. [4] revealed that "ridge and furrow sowing of soybean should be advocated over flatbed sowing mainly due to their ability to save irrigation water. Kumari and Rao [5] reported that the crop growth rate and net assimilation rate were higher when crops are planted on ridge and furrow or bed planting system for mustard." Jadhav et al. [6] and Dhakad et al. [7] found "higher growth parameters, yield and yield attributes parameters in ridge and furrow system over flat sowing system in soybean." Similar trends reported by

Bhargav et al. [8]. In view of the above findings and its importance in soil moisture conservation, reduced cost of cultivation the study was undertaken. Climate change is placing a growing strain on the land and natural resources that India's farmers rely on, not just to provide food for the country, but to also sustain livelihoods. At present, some 30 percent of land is experiencing degradation, and rising temperatures means agriculture needs 30 percent more water. Innovative methods are emerging across India to help farmers adapt to the pressures stemming from climate change and to mitigate the impacts of their farming methods. An innovative method of Ridge and furrow cultivation and its impact on growth and yield of groundnut crop in Chittoor district of AP.

2. MATERIALS AND METHODS

The field experiment was conducted at the farmer's fields in Chittoor district of Andhra Pradesh during Kharif and Rabi seasons 2020 and 2021. The field study was performed with ridge and furrow system. Ridge and furrows were prepared with the help of tractor and to make the ridge and furrow system an extra punji is attached on the back tines of tractor operated seed-cum-fertilizer drill machine. The width of punji depends upon the row to row distances. Sowing seeds by front line tines and covering them by soil took place by punji attached in back line tines. Thus lines of groundnut automatically come over ridge favored by formation of alternate furrows. This ridge and furrow system involves sowing of crop at a row spacing of 30 cm and 10 cm between crops in red soil. The average rainfall of 526.6 mm and 639.2 mm received during the year 2020 and 2021 respectively. The Ground nut crop (variety Kadiri-1812) was sown for the study. The recommended dose of fertilizers (25:50:0 NPK kg/ha). The plant growth character and yield contributing data such as are plant height, root length, number of root nodules per plant, number of pods per plant, number of seeds per pod, seed yield per plant, seed yield, straw yield, water use, pest and disease incidence were recorded of groundnut crop for sown by ridge and furrow system and flat sowing.

Harvest index is the ratio of economic yield (kg/ha) to biological yield (kg/ha) and multiplied by 100 to obtain its value in percentage. It indicates the efficiency of plant material to convert the photosynthetic in to the economic yield and it is worked out as:

Harvest index (%) = Economic yield (kg/ha) / Biological yield (kg/ha) X 100 (1)

Where, the biological yield = Seed yield + Straw yield.

Water Use Efficiency (WUE) is defined as the amount of carbon assimilated as biomass or grain produced per unit of water used by the crop.

Water use efficiency (WUE) = Dry matter production (kg/ha) / ET (in mm).

2.1 Economic Analysis

2.1.1 Cost of cultivation

The cost of cultivation (Rs/ha) of each treatment was worked out by considering the price of inputs, charges for cultivation, labour and other charges.

2.1.2 Gross monetary returns

The gross monetary returns (Rs/ha) occurred due to different treatments in the present study were worked out by considering market prices of economic product, by product and crop residues during the experimental year.

2.1.3 Net monetary returns

The net monetary returns (Rs/ha) of each treatment were worked out by deducting the mean cost of cultivation of each treatment from the gross monetary returns gained from the respective treatments.

2.1.4 Benefit: Cost ratio

The benefit: cost ratio of each treatment was calculated by dividing the gross monetary returns by the mean cost of cultivation.

3. RESULTS AND DISCUSSION

The plant development and yield parameters were determined to be better in the ridge and furrow system than in the regular flatbed sowing system, as shown in Table 1. It is because excess rainfall is properly directed through furrows. It also increases water-use efficiency both under rainfed and irrigated scenarios because water moves laterally from furrows into beds thereby reducing evaporation losses. The plant population/m^2 ranged 8-13% higher on

planting groundnut using ridge and furrow method as compared to planting on plane land with normal seed drill. The number of root nodules per plant produced by flat surface sowing was the lowest; however, the number of root nodules per plant produced by the ridge and furrow approach was the highest. The ridge and furrow method had the highest yield of 2080 kg/acre, whereas the normal system had the lowest. Further lesser incidence of pest and diseases as well as better aeration within furrows. Weed population reduced on ridge and furrow method of planting. The ridge-furrow method of planting groundnut has been reported to save seed and water by 25-30% and fertilizer by 25%, yield enhancement to the extent of 8-23% higher compared to the normal flatbed sowing method. Similar results were reported by Basediya et al. [9].

Table 2 shows the economic analysis of groundnut. It shows that the ridge and furrow approach yielded a greater net return of Rs. 83,730 per ha with a BCR of 5.13, whereas regular flatbed sowing yielded the lowest net return of Rs 33,850 per ha with a BCR of 2.20 for the years 2020-21 and 2021-22. Bhargav et al. [8], Dhakad et al. [7], and Basediya et al. [9] all found similar findings. They came to the conclusion that ridge and furrow planting yielded higher gross and net monetary returns than the standard approach.

Table 1. Growth character and yield attributes of groundnut

Parameter	Flat bed method of planting (acre)	Ridge and furrow method of planting (acre)
Seed rate (Kg)	45	28
Plant population (No./m^2)	60 -54	44
Number of root nodules per plant at 60 DAS	60-70	90-100
Number of pods per plant	45-50	65-70
Seed yield weight per plant (g)	51.75-57	78-84
Seed yield (kg/acre)	1240	2080
Straw yield (kg/acre)	1820	1956
Harvest index (%)	40.52	51.53
Water use efficiency	0.50	0.70
Pest and Disease incidence	20-25%	5-10%
Yield		
Cost of cultivation	28,150	24,300
Gross monetary returns	62,000	1,04,000
Net monetary returns	33,850	83,730

Table 2. Economics analysis of soybean production

Parameter	Flat bed method of planting	Ridge and Furrow method of planting
Land preparation	2,800	3,600
Seed	6,750	4,200
Organic fertilizers	1,500	2,800
Sowing	1,600	1,200
Weed management and Intercultivation	2,500	1,000
Pesticides	4,000	1,600
Fertilizers	1,500	670
Harvesting and Threshing	7,500	5,200
Total cost of cultivation	28,150	20,270
Yield in bags (40 kg per bag)	31	52
Price per bag	2,000	2,000
Benefit: cost ratio	2.20	5.13
Gross monetary returns	62,000	1,04,000
Net monetary returns	33,850	83,730

Fig. 1. Groundnut raised in ridge-furrow method during Rabi season 2021

Fig. 2. Groundnut raised in ridge-furrow method during Kharif season 2020-21

4. CONCLUSION

According to the findings of this study, the ridge and furrow planting system of groundnut produced better results for two consecutive years in terms of growth and yield characters than the traditional method of sowing, i.e. normal flatbed sowing. It is concluded that ridge and furrow method of sowing should be promoted over flat surface sowing mainly due to the soil moisture stored protract the crop during dry spells, lesser weed population, save seed and water, lesser incidence of pest and diseases as well as better aeration within furrows.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/80950