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Effect of mechanization and land configuration on growth of soybean (*Glycine max* (L.) Merrill)

SB Thoke, BV Asewar, PP Shinde and RM Poul

Abstract
An Agronomic investigation "Effect of mechanization on productivity, growth, yield and economics of soybean" (*Glycine max* (L.) Merill)" was carried out at Experimental farm, of AICRP for dryland Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during *kharif* 2019. The experiment was conducted which consisted of three treatments of mechanization practices as main plots and three treatments of moisture conservation as sub plots constituting six treatment combinations which were replicated thrice in split plot design. The three mechanization practices of full mechanization (M_1), partial mechanization (M_2) and no mechanization (M_3) were tested with three moisture conservation practices i.e. Broad bed furrow (S_1), ridges & furrow (S_2), flat bed (S_3) in the investigation. The gross and net plot sizes were 4.5m x 18m and 3.6m x 15m, respectively. The crop was sown as per treatments with recommended spacing of 45cm x 5cm. The growth parameters were influenced by various treatments of mechanization practices. The growth parameters like plant height, number of functional leaves plant^{-1}, leaf area plant^{-1}, number of branches plant^{-1}, total dry matter accumulation plant^{-1} were significantly higher in mechanization practices of full mechanization (M_1) treatment followed by partial mechanization (M_2) and no mechanization (M_3). The growth parameters were influenced by various moisture conservation. Broad bed furrow (S_1) recorded highest plant height (cm), maximum number of functional leaves plant^{-1}, leaf area plant^{-1}, number of branches plant^{-1} and total dry matter accumulation plant^{-1}. The interaction effects between mechanization practices and moisture conservation not significantly influenced the growth and yield of soybean Thus to achieve higher soybean yield may be sown with full mechanization and broad bed furrow method.

Keywords: Mechanization, moisture conservation, labour shortage, soybean

Introduction

Soybean (*Glycine max* (L.) Merill) is also called as wonder crop. It is native of Asia and it has been under cultivation in China since 2838 B.C. It belongs to the family Leguminaceae and sub family Papilionaceae. Soybean is basically a pulse crop but is gaining importance as an oilseed crop too. Soybean is of paramount important in human and animal nutrition, because it is a major source of edible vegetable oil and high protein feed as well as food in the world.

Mechanization is the common practice in most agricultural land. However, in the past two decades or so, several development in the field of agriculture have dictated drastic changes in mechanization practices. First availability of herbicides capable for controlling most of the major weed has become available at the reasonable cost. This development reduced the need for cultivating and even ploughing in some cases. Second, drastic increases in fuel cost forced tractor- dependent farmers to seek means of reducing their tillage operation cost. Third, the increasing environmental awareness has forced a re-evalution of soil erosion as source of off-site water pollution.

The term mechanization needs to be viewed for its broader purpose, namely, enhancing safe and sustainable productivity of land and labor. Actually, an agriculture mechanization strategy should be part of an agriculture technology strategy which in turn should be a part of an overall agriculture development strategy. The introduction of machinery to substitute for labor (labor saving) is a common phenomenon associated with the release of labor for employment in other sector of the economy or to facilitate cultivation of a larger area with the same labor force. The purpose of mechanization is also to produce more from the existing land, using machinery as a complimentary input, required to achieve higher land productivity. During resent years, a continuous shift of rural population towards services sector for better working conditions, increasing urbanization and migration of villagers in search of greater opportunities, rise of rural entrepreneurs, etc. has resulted into the shortage of agriculture labor. (Grover *et al.* 2014) [8].

The labor scarcity being felt as a major impediment in agriculture, this study has probed into its magnitude, impacts, causes and possible solutions in the Cuddalore district of Tamil Nadu. The study has revealed that prevalence of acute labor scarcity in the district has affected the productivity levels of almost all crops and is even leading towards the permanent changes in the cropping pattern. The important reasons identified for the labor scarcity include higher wages in other locally-available jobs, seasonal nature of agricultural jobs and presumption of an agricultural job to be of low esteem. The level of adoption of labour-saving implements and technologies by the farmers is very low for the reasons of higher cost, lack of skill and smaller size of holdings. The study has suggested that agricultural extension system of the district / state / country should be geared-up, to bring out farmers from the conventional methods of cultivation and to educate them on adoption of labor-saving implements and technologies. Also, a community level approach should be encouraged among farmers for adopting / availing highly expensive labour-saving technologies and implements cooperatively. In addition, agricultural jobs should be made more remunerative by increasing the wages at least at par with other jobs available locally. (Prabhakar *et al.* 2011) [17]

Land configuration is the combination of soil management and the potential to improve the productivity of alfisols and vertisols in the semi arid tropics. The land configuration treatment were FB (flat bed-traditional practices), Ridges and furrow and BBF (broad bed furrow) are applied to field for better water conservation, increase soil fertility and productivity of cropping system. Proper land configuration is known for increasing moisture intake, storage and resultant yield. The broad bed and furrow help in providing more opportunity for in situ soil water conservation in rainfed Agriculture.

Materials and Methods

A field experiment was conducted during *kharif* 2018-19 at All India Co-ordinated Research Project on Dryland Agriculture, V.N.M.K.V, Parbhani. The soil was medium deep black and well drained. The topography of the experiment field was fairly uniform and leveled. Soil samples up to 30 cm were randomly collected from different locations of field before start of the experiment during *kharif* 2019. The results of the soil analysis revealed that, the soil of the experimental plot was clayey in texture, low in available nitrogen (198.40%), medium in available phosphorus (13.89%), high in available potassium (480.10%) and slightly alkaline in reaction. The soil was moderately alkaline in reaction (8.00 pH). In general, weather conditions were favorable for plant growth and no severe pest and diseases noticed during experimentation. The study involved six treatment combinations two factors *viz*., mechanization plot (MP) and moisture conservation practice (MC) with two treatments. Sowing was completed as per treatments. The fertilizer dose of 30:60:30NPK kg ha^{-1} was applied at the time of sowing. The package of recommended practices was adopted to maintain the crop.

Table 1: Growth character of soybean for mechanization and moisture conservation practices

Treatments	Plant height	Mean no of branches plant^{-1}	Mean no of functional leaves plant^{-1}	Mean leaf area plant^{-1}	Dry matter accumulation plant (g)
Main plot treatment (Mechanization)					
M_1=Full Mechanization	69.77	5.66	19.98	3.19	22.63
M_2=Partial Mechanization	62.04	5.61	18.13	2.24	18.02
M_3=No Mechanization	43.38	3.47	14.82	1.17	14.79
S.E m±	0.30	0.02	0.12	0.12	0.59
C.D at 5 %	1.06	0.07	0.42	0.45	2.10
Sub plot treatment (Moisture conservation)					
S_1=Broad bed furrow	62.76	5.14	18.08	2.91	2.23
S_2=Ridges and furrow	58.02	4.88	17.55	2.25	18.13
S_3= Flat bed	55.40	4.77	17.01	2.03	17.07
S.E m±	0.30	0.08	0.10	0.11	0.40
C.D at 5 %	0.92	0.20	0.32	0.33	1.22
Interaction (TxL)					
S.E m±	1.85	0.19	0.32	0.20	0.83
C.D at 5 %	NS	NS	NS	NS	NS
General mean	58.73	4.93	17.88	2.40	18.45

Result and Discussion

Effect of Mechanization

Data pertaining to the effect of various treatments growth parameters are presented in table 1. Treatments (M_1) full mechanization produced more plant height than (M_2) partial mechanization and (M_3)no mechanization. This might be due to favorable seed bed, aeration, more conservation of water in full mechanization and initial vigorous growth resulted in more height of the crop. These results are conformation with the results of Bhutada *et al.* (2020) [5], Asewar *et al.* (2019) [2] pochi and Fanigiulo *et al.*(2010) [16],

The number of functional leaves increased rapidly upto 75 DAS and decreased thereafter till maturity due to leaf senescence. treatment (M_1)full mechanization proved superior over all the treatments in producing more leaves plant^{-1} and maximum leaf area plant^{-1}. This might be due to overall favourable growth and more number of functional leaves produced in treatment (S_1) Broad bed furrow which in turn resulted in more leaf area plant^{-1}. The similar results are reported by Dhakad *et al.* (2014) [7], Baig *et al* (2014) [3] and Jadhav *et al.* (2011) [9].

Number of branches plant^{-1} differed with the different treatments. Mechanization practice (M_1) full mechanization recorded the maximum number of branches plant^{-1} at all the stages of crop growth than (M_2) partial mechanization and (M_3) no mechanization. Treatment M_3 (no mechanization) recorded the lowest number of branches plant^{-1}.

Total dry matter accumulation (g) plant^{-1} increased rapidly up to 75 DAS and gradually decreased thereafter till maturity. mechanization practice (M_1) full mechanization recorded more dry matter accumulation than (M_2)partial mechanization and (M_3) no mechanization in soybean. This might be due to luxurious growth and higher growth attributes recorded in full mechanization than rest of the mechanization practices and thus overall growth reflected in higher dry matter in full mechanization practice. The similar results were observed by Tenu *et al.* (2009) [20], Kadu *et al.* (2004) [10].

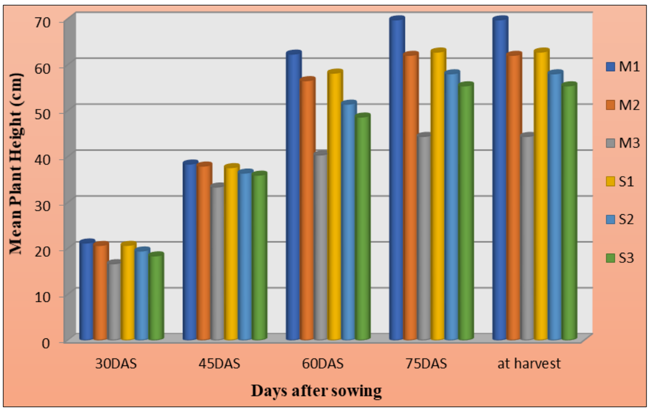

Fig 1: Plant height (cm) as influenced by various treatments in soybean

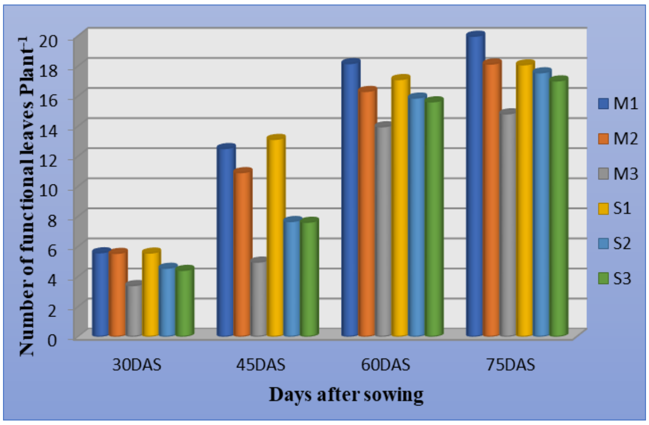

Fig 2: Number of functional leaves plant^{-1} as influenced by various treatments in soybean

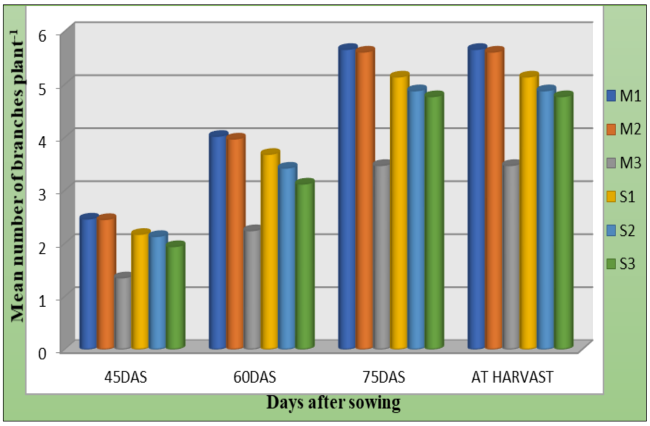

Fig 3: Number of branches plant^{-1} as influenced by various treatments in soybean

Effect of Moisture conservation

The effect of moisture conservation observed to be profound at all the stages of crop growth. Significant differences were observed in various growth and yield attributing characters, grain and straw yield ha^{-1} due to various moisture conservation. Treatments (S_1) broad bed furrow produced more plant height than (S_2) ridges & furrow and (S_3) flat bed. This might be due to favorable seed bed, aeration, more conservation of water in broad bed furrow and initial vigorous growth resulted in more height of the crop. These results are conformation with the results of Asewar *et al.*, (2017) [1], Verma *et al.*, (2017) [21], Khambalkar *et al.*, (2014) [11], Chandwat *et al.*, (2003) [6], Patel *et al.*, (2009) [14], Singh *et al.*, (2011) [19].

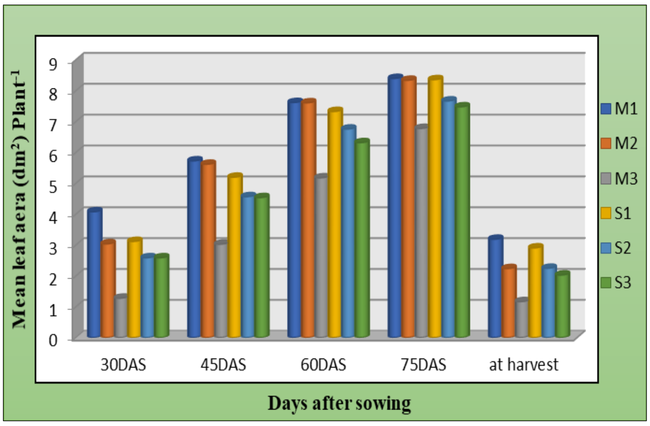

Fig 4: Leaf area (dm^2) plant^{-1} as influenced by various treatments in soybean

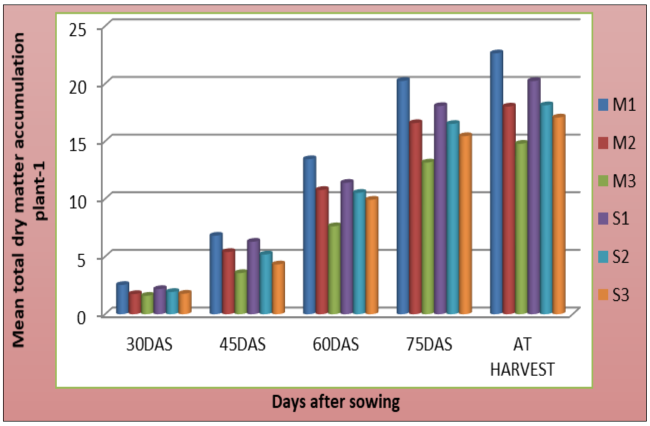

Fig 5: Mean total dry matter accumulation (g) plant^{-1}of soybean influenced by various treatment

The number of functional leaves plant^{-1} increased rapidly upto 75 DAS and decreased thereafter till maturity due to leaf senescence. Treatment (S_1) broad bed furrow proved superior over all the treatments in producing more number of leaves plant^{-1}. This might be due to height and further vigorous growth and accordingly more photosynthesis in BBF. Similar results were obtained by Bharde *et al.*, (2019) [4], Jadhav *et al.*, (2011) [9].

Leaf area plant^{-1} increased rapidly up to 75 DAS and decreased gradually till maturity of the crop due to leaf senescence .The profound effect of land configuration methods on leaf area was found at all the growth stages. It was observed that treatment (S_1) broad bed furrow had maximum leaf area plant^{-1} (dm^2) than (S_2) ridges & furrow and (S_3) flat bed. This might be due to overall favorable growth and more number of functional leaves produced in treatment (S_1) broad bed furrow which in turn resulted in more leaf area plant^{-1}. The similar results are reported by Negi *et al.*, (2018) [13], Rudrawar (2007) [18]. Dhakad *et al.*, (2014) [7].

Number of branches plant^{-1} differed with the different treatments. moisture conservation (S_1) broad bed furrow recorded the maximum number of branches plant^{-1} at all the stages of crop growth than (S_2) ridges & furrow, and (S_3)flat bed. Treatment (S_3) flat bed recorded the lowest number of branches plant^{-1}. This might be due to the more plant height and vegetative growth of the plants grown on BBF. Moreover, the space available for side rows on BBF was more than that of ridges & furrows and flat bed system. This was supported by more water conservation and vigorous branching in plants raised on BBF. Similar results were reported by Kumari and rao (2005) [12] and Rudrawar (2007) [18].

Total dry matter accumulation (g) plant^{-1} increased rapidly up to 75 DAS and gradually decreased thereafter till maturity. The rate of increase in dry matter (g) plant^{-1} was comparatively slow during 30 to 45 DAS and was fast during 46 to 75 DAS, which was due to grand growth of crop with maximum number of leaves, branches and pods during this period. Moisture conservation method (S_1) broad bed furrow recorded more dry matter accumulation than (S_2) ridges & furrow and (S_3) flat bed in soybean. This is due to luxurious growth and higher growth attributes recorded in (S_1) broad bed furrow than rest of the moisture conservation and thus overall growth reflected in higher dry matter in broad bed furrow planted crop. The similar results were observed by Pendke *et al.*, (2000) [15].

Conclusions

On the basis of this study, the better results were found in full mechanization (M_1) along with Broad bed furrow (S_1) on growth characters of soybean as compared to no mechanization along with conventional method i.e flat bed. It is concluded that full mechanization along with Broad bed furrow found most suitable for increasing soybean yield and productivity mainly due to the soil moisture stored sustain the crop during crop growing period. The conclusions are drawn on the basis of one year experimentation. Hence, need further experimentation for confirmation of the results.

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