STUDIES ON INFLUENCE OF BROAD BED AND FURROW SYSTEM IN *IN-SITU* SOIL MOISTURE CONSERVATION, YIELD AND ECONOMICS OF SAFFLOWER (CARTHAMUS TINCTORIUS L.) UNDER RECEDING SOIL MOISTURE CONDITIONS.

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Abstract: Safflower is an annual oilseed crop grown predominantly as rainfed crop during Rabi (post rainy season). The important Safflower growing districts in Telangana are located in the dry regions of the state and the bulk of the crop is raised under receding soil moisture. Further, Safflower is predominantly grown in a fallow-Safflower rotation allowing possible run-off losses of the incidental rains received during non-cropped *Kharif* season (June to September). In this context, there is a need to adopt the *in-situ* based soil conservation practices to enhance the soil moisture. Broad bed and furrow (BBF) farming is a novel concept for conservation of rain water in of dry land areas. Hence, a comparative analysis of the BBF method of cultivation *vis-a-vis* traditional method of flat-bed sowing was has been made during Rabi 2014-15 with the main objectives to study the yield and economics of Safflower; and to assess the moisture conservation efficiency of the system.

The field experiment was conducted on a medium black soil at Agricultural Research Station, Tandur, Telangana state during Rabi 2014-15. The performance of Safflower was studied under 2 treatments (T1 - BBF method of cultivation and T2 - Traditional method of flat-bed sowing). Safflower hybrid DSH-185 was sown in an area of 0.2 ha. each under BBF and traditional system. The treatment statistical variations between BBF method of cultivation and traditional method of flat-bed sowing were analysed by subjecting the sample means to t-test.

The productivity of Safflower under BBF method was 2091 Kg/ha and there was 52.8% enhancement over conventional cultivation (1369 Kg/ha.). Cultivation of Safflower under BBF method of planting gave higher net returns (Rs. 43247) as compared to Farmers practice (Rs. 35574) with 21.6 % higher than latter. The benefit cost ratio with BBF method was markedly superior (3.34) over Traditional method of sowing (3.18). The average soil moisture for BBF method was found to be 24.60%, 21.75% and 16.15 % at 0 to 15 cm depth and at 35, 55 and 75 days after sowing, respectively and it was 28.90%, 26.32% and 23.54% at 15 to 30 cm depth. This accounted to 24.68%, 30.63% and 34.02% higher available soil moisture at 0 to 15 cm ; and 12.32%, 17.76% and 29.34% improvement in available soil moisture at 15 to 30 cm depth, respectively.

BBF method showed effective conservation of soil moisture than in traditional method which was reflected in improved seed yields of Safflower in Rabi season under receding soil moisture conditions. Maximum attainable available soil moisture at different crop growth stages is possible with BBF method of sowing.

Introduction: Safflower is an annual oilseed crop grown predominantly as rainfed crop during Rabi (post rainy season). The important Safflower growing districts in Telangana are located in the dry regions of the state and the bulk of the crop is raised under receding soil moisture. Further, Safflower is predominantly grown in a fallow-Safflower rotation allowing possible run-off losses of the incidental rains received during non-cropped *Kharif* season (June to September). The quantum of soil moisture stored at the beginning of the crop season hold the key for enhancing the productivity and resilience to counter the uncongenial climate in Rabi rainfed situations. The watershed based conservation methods under practices are suitable only for low lying areas and equitable moisture distribution to tail-end fields under a particular watershed area cannot be ensured. In this context, there is a need to adopt the *in-situ* based soil conservation practices to enhance the soil moisture. Broad bed and furrow (BBF) farming is a novel concept for conservation of rain water in case of dry land areas and to overcome water logging and improve soil structure on cropping soils in case of high rainfall zone (Khambalkar, et. al., 2010). Majority of the rainfed farmers i.e., 91.43 percent know the proper method of land preparation and 71.43 percent of farmers know the method of opening up broad bed and furrows using appropriate BBF implements (Bheemappa et. al., 1994). In broad bed furrow farming, the soil is cultivated to depths of up to 30 cm and then formed into narrow beds of between 1.7 to 2.0 m in width. Soil from the furrows positioned down each side of the beds is thrown on the tops of the beds, resulting in an increase in the height of the soil up to 5 cm. The height of the bed above the furrow base usually ranges from 15 to 30 cm which depends on the depth of prior cultivation of crops (Gupta and Undadi, 1994). The furrows act as pathways for drainage in excessive rain and conserve rainwater in dry spell (Astatke et al., 2002). Sowing the crop under the BBF system is an emerging practice in rainfed farming for sustainable yield. *In-situ* water conservation makes the moisture availability for the sown crops throughout the length

of the growing period evading terminal drought stress which is a recurrent phenomenon in Safflower grown under receding soil moisture conditions. BBF method is a time tested technology in crops like Groundnut, Potato, various vegetables etc., and there is a need to extrapolate this system to Safflower for maximising the yields and economics. Hence, a comparative analysis of the BBF method of cultivation *vis-a-vis* traditional method of flat-bed sowing has been made during Rabi 2014-15 with the main objectives to study the yield and economics of Safflower; and to assess the moisture conservation efficiency of the system.

Methodology: The field experiment was conducted on a medium black soil at Agricultural Research Station, Tandur, Telangana state during Rabi season of 2014-15. A total rainfall of 658 mm has been received from April to September, 2014 as against the decennial average of 745 mm for the corresponding period. The performance of Safflower was studied under 2 treatments (T1 - BBF method of cultivation and T2 - Traditional method of flat-bed sowing). Safflower hybrid DSH-185 was sown in an area of 0.2 ha. each under BBF and traditional system on 17-10-2014 adopting all other recommended package of practices uniformly for both the systems. In BBF system the sowing pattern has been changed by introducing the broad bed furrows in crop rows. A BBF was introduced between two pair rows for moisture conservation. In BBF farming, the soil is cultivated to form fine tilth up to 45 cm and then formed into narrow beds of between 45 in width. Soil from the furrows positioned down each side of the beds is thrown on the tops of the beds, resulting in an increase in the height of the soil up to 15 cm from the base of the furrow. Two rows of safflower were sown on the beds at 35 cm apart leaving 5 cm margin on either side. A uniform furrow width of 25 cm was maintained all through. Thus, each BBF with 45 cm width was separated by 25 cm wide furrow. The plant to plant spacing was 20 cm. This crop geometry resulted in a plant population of 143 plants per 10 m^2. Whereas, the recommended spacing of 45cm X 20cm was followed in conventional flat-bed sowing treatment to result in a plant stand of 111 plants per 10 m^2. In present research work BBF marker cum seed drill was used for ease in formation of suitable furrows and row to row spacing of crop. The data pertaining to seed yield was computed from the samples drawn from 15 random rows of 10 m each in both the systems. The data regarding moisture content of soil in both methods with the yield of crop was collected during the research work. For determining moisture content of soil fifteen samples of soil were selected randomly at two different depths, i.e. 0-15 cm, and 15-30 cm from experimental plot. The readings were taken for both BBF method and adjacent field of traditional method at sowing, 35, 55 and 75 days after sowing. The treatment statistical variations between BBF method of cultivation and traditional method of flat-bed sowing were analysed by subjecting the sample means to t-test (Steel and Torrie, 1980).

Results & Discussion: It is evident from the results presented in Table 1 that the BBF method of Safflower cultivation had an increased economic benefit over Flat-bed method of sowing. The productivity of Safflower under Broad bed and furrow method was 2091 Kg/ha (Table 1.) and there was 52.8% enhancement over conventional cultivation (1369 Kg/ha.). This may be due to the fact that deep vertisols have soil moisture storage up to 250 mm, which is sufficient to support plants through mid-season or late-season spells of drought. This agrees with the findings of Khambalkar et. al., (2010) who reported the superiority of BBF method and reported that the yield in BBF farming was 6.5 % more than that of traditional method due to conservation of soil moisture through the broad bed furrows.

The economic viability of the BBF system over conventional sowing method was computed taking into account the prevailing input costs and output market prices. Cultivation of Safflower under BBF method of planting gave higher net returns (Rs. 43247) as compared to Farmers practice (Rs. 35574) with 21.6 % higher than latter. The benefit cost ratio with BBF method was markedly superior (3.34) over Traditional method of sowing (3.18). Similarly, comparative studies on resources requirement, production cost, crop yield and net returns across alternative tillage system was carried out for large scale mechanized farm by Stonehouse, (1991).

Considerable improvement in gravimetric soil moisture content was observed at different crop phonological phases and depths (Table 2.). The average soil moisture for BBF method was found to be 24.60%, 21.75% and 16.15 % at 0 to 15 cm depth and at 35, 55 and 75 days after sowing, respectively and it was 28.90%, 26.32% and 23.54% at 15 to 30 cm depth. This accounted to 24.68%, 30.63% and 34.02% higher available soil moisture at 0 to 15 cm ; and 12.32%, 17.76% and 29.34% improvement in available soil moisture at 15 to 30 cm depth, respectively.

Conclusions: Conservation of rainwater in rainfed agro-ecology has great importance to improve the crop productivity. Broad bed and furrow method of sowing thus offers a better opportunity to maximize the yield and economics of Safflower. BBF method shows effective conservation of soil moisture than in traditional method which was reflected in improved seed yields of Safflower in Rabi season under receding soil moisture conditions. Maximum attainable

available soil moisture at different crop growth stages is possible with BBF method of sowing.

Table 1. Means and T-values of Yield and economics of Safflower among Broad bed and furrow system; and Conventional flat-bed sowing (2014-15)

Variable Definition	Yield and Economics of Safflower				Percent improvement over flat-bed method	T-test
	BBF Method of sowing		Flat-bed Method of sowing			
	Mean	St. Dev.	Mean	St. Dev.		
Mean Seed Yield (Kg/ha.)	2091	43.63	1369	52.75	52.8	40.88*
Gross Returns (Rs./ha.)	61697	1287.35	51914	2000.78	18.8	15.92*
Net Returns (Rs./ha.)	43247	1287.35	35574	2000.78	21.6	12.49*
B:C Ratio	3.34	0.069	3.18	0.122	-	4.58*

**Significant at 5% significance level*

Table 2. Gravimetric Soil Moisture Content (%) at different crop phonological stages and at various depths.

Treatments	At sowing	At 35 DAS		At 55 DAS		At 75 DAS	
	0-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
T_1 – Broad-bed and furrow method	31.18	24.60	28.90	21.75	26.32	16.15	23.54
T_2 – Flat bed method of sowing	31.00	19.73	25.73	16.65	22.35	12.05	18.20
Percent improvement in ASM over flat-bed method	0.58	24.68	12.32	30.63	17.76	34.02	29.34

References:

1. Bheemappa A, Meti S K and Hanchinal S N 1994. Effectiveness of Broad bed and Furrow method of Groundnut cultivation as perceived by farmers. Karnataka J. of Agric. Sci., 7(2) : 205-210
2. Khambalkar K P, Nage1 S M, Rathod C M, Gajakos A V and Shilpa Dahatonde 2010. Mechanical sowing of safflower on broad bed furrow. Australian J. of Agric. Engg., 1(5) : 184-187
3. Gupta C P, Undadi A 1994. Development of two wheel tractor operated seed-cum-fertilizer drill. AMA 25(1): 25-28
4. Steel R G D and Torrie J H 1980. Principles and Procedures of Statistics, Second Edition, New York: McGraw-Hill Book Company.
5. Astatke A, Jabbar M, Mohamed MA and Erkossa T 2002. Technical and economical performance of animal drawn implements for minimum tillage-experience on vertisols in Ehopia. Experimental Agriculture, 38(2): 185-196
6. Stonehouse D P 1991. The economics of tillage for large-scale mechanized farms. Soil & Tillage Research, 20: 333-351.

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