Egypt. J. Agric. Res. , 77 (3) ,1997

COMPARISON OF FARMER'S PRACTICE VERSUS IMPROVED PRODUCTION TECHNOLOGY OF SORGHUM UNDER MEDIUM RAINFALL CONDITIONS IN PAKISTAN

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(Manuscript received 21 April 1998)

Abstract

Crop production is primarily water limited under dry farming systems in rainfed conditions. This study was conducted to investigate the difference between farmer's practice and improved production technology for sorghum fodder and grain besides economic return. Four treatments comprising, two farmer's practices and improved production practices with and without fertilizer were carried on farmers field during 1989-91. Nutrients doses used for fertilizer treatments were 57:57 NP kg ha^{-1}. Green fodder yield, dry stalk and grain yield were 4516, 8202 and 1201 kg ha^{-1}, respectively with improved production technogy. This was followed by farmer's practice with fertilizer and improved practice without fertilizer. The lowest values of 1732, 8253 and 538 kg ha^{-1} were obtained with farmer's practices without fertilizer for green fodder, dry stalk and grain yield, respectively. Partial budgett analysis revealed that addition of fertilizer to farmer's practice and addition of improved production technology alongwith fertilizer gave marginal rate fo return (MRR) 188% and 417% from green fodder and 392% and 509% from dry stalk + grains. By eliminating treatments farmers practice with fertilizer from benefits curves, the MRR between improved practice with and with out fertilizer from benefits curves, the MRR between improved practice with and with out fertilizer from benefits curves, the MRR between improved practice with and with out fertilizer stand was 198% and 221% from green fodder and dry talk + grains. It is concluded even by adopting one or two components of the improved production technology, farmer could achieve good rate of return.

INTRODUCTION

The main rabbi crop in the medium rainfall (500-750 - mm yr^{-1}) area is wheat (Triticum aestivum L.). Field mustard (Brassica caprestris) is generally intercropped with wheat to feed the livestock. Pulling of plants for fodder usually starts in the month of January and continues upto March. sorghum (Sorghum bicolor L.) is the main fodder crop durign kharif (summer) season in the Fatehjang area (Supple et al; 1985). Sorghum cultivation is about 60% of the total cropped areas during kharif season; 23% of that area is devoted for fodder production.

Sorghum stands as the first most important green fodder during July-August and second important during Septeber-October as dry stalk. Dry stalk is stored to make hay for lean period during November-January to feed the livestock or to sell fodder in the market to gain cash (Sheikh et al; 1988). Similarly, importance of sorghum grain is also increasing day by day due to expansion of poultry industry in the area where it is utilized as a feed component.

Sorghum cultivation exits in the prevailing cropping system; wheat + mustard-sorghum-fallow-fallow-wheat+ mustard and pulses-sorghum-wheat+mustard-sorghum, also called "Dofasla-dosala" i.e. two crops in two years (Sheikh et al; 1988). Farmers of this area comply longer fallows in response to low fertility and erratic and uneven rainfall during the season. Raiput et al. (1983) reported that row spacing of 30 cm with optimum level of fertilizer (30:330 NP kg ha^{-1}) produced the economical yield of grain sorghum. Maximum sorghum yield under rain fed conditions can be achieved by applying 150 kg ha^{-1} of nitrogen (Shuka et al; 1968). Improved varieties, CSH-1, CSH-6 and BR-123 were found more adaptive and stable as compared to old sorghum varieties (Bhossale et al; 1983; Khan et al; 1989). Generally, farmers of te medium rainfall area plant sorghum by broadcastt method without fertilizer and use local and low yielding varieties. They obtained very poor stand, low green fodder and grain yield; may be due to non-adoption of improved production technologies. Therefore, a study was conducted at farmer's field to examine the yield performance and adaptability of improved sorghum variety in accordance with farmers need and circumstances.

MATERIALS AND METHODS

A field study was conducted at the farming System Research (FSR) target area, Fatehjang, to compare the farmer's practice (FP) with improved production technology (IP) of sorghum (Sorghum bicolor L.) from 1989-91. A major portion of the FSR intervention were conducted on Guliana (heavy textured, deep and moderate drainage) and missa (well drained) soil series. These soils were monitored to store 122-126 mm plant available moisture upto 1.5 m depth (Sandhu et al; 1987). The soil type was clay loam at all locations. Seed bed prepared by the farmers at each site by giving three ploughings followed by two plankings. Each field was divided into four parts having plots size 15 m x 20 m every year. Following treatments were randomly (inter & intra fields) arranged in a randomised complete block design (RCB) and each location was consider as one replication.

FPFO = Farmer' Practice without fertilizer.
= Local variety
= Broadcast Method
IPFO = Improved practice without fertilizer
= Improved variety, BR-123
= Drill sowing
FPIF = Farmers practice with fertilizer
= Local variety
= Broad cast method
= Fertilizer 57-57 NP kg ha^{-1}
IPIF = Improved practice with fertilizer
= Improved variety, BR-123
= Drill sowing
= Fertilizer 57-57 NP k ha^{-1}

Crop was planted by the four farmers with the help of FSR team in the second week of July at all site each year. Sorghum local variety was planted by broadcast method and improved variety was planted with single row hand drill at of 80 Kg ha^{-1}. However, distance of 30 cm between rows was maintained for improved practice treatments. Fertilizer at rate of 57-57 NP k ha^{-1} was broadcast at sowing. It was expected that phosphorus might have some carryover effects on preceding wheat crop while nitrogen might have no carryover effects due to denitrification, leaching etc; (Gakale and Clegg; 1987). Unfortunately, we could not manage to work out NP status of the soil for wheat because farmers managed their land for two years rotation (Dofasla-dosala). Data on different agronomic traits; green fodder, dry stalk, grain yield and agrometeriology were recorded. Green fodder samples were taken at 50% anthesis stage and grain yield were taken at maturity by harvesting five random samples of two m2 from each treatment. At harvest, one sample from each treatment was randomly selected, dried, weight and stored as dry stalk. All these observations were calculated on kg ha-1 basis for presentation. Data were statistically analysed by using MSTAT and differences among treatment means were compared using the least significance difference (LSD test) at 0.01 probailitty level (Steel and Torrie, 1980). Economic analysis was worked out to estimate the net benefits gained by the adoption of improved technology. Economics were calculated for green fodder and dry stalk + grain yield kg ha-1 because farmers utilized some portion of crop for green fodder while other as hay (dry stalk and grin). Partial budgeting for farmers practice and improved production technology was done by

adjusting the actual yield downward by as ten percent adjusted yield (CIMMYT, 1988) and the cost benefit calculations were made on three years average basis.

RESULTS AND DISCUSSION

Comparison of farmer's practice and improved production technology of sorghum was investigated for green fodder, dry stalk+ grain yield and net benefits.

Green Fodder yield

Improved production technology (IPIF) produced maximum green fodder yield (34483 kg ha-1) throughout the study period. Farmer's practice with improved fertilizer (FPIP) produced 334% less green compared to IPIF. However, FPIF treatment was statistically non-significant with improved practice without fertilizer IPFO. Farmer's practice without fertilizer (FPFO) attained 22% less green fodder even when compared with IPFO (Table 1). During the year 1990 an and 1991 all the treatments except improved production technology (IPIF) were statistically non-significant. In the year 1989, FPFO gave significantly lower green fodder yield compared to IPIF, FPIF and IPFO, whereas IPIF produced significantly higher yield than IPFO and FPIF.

Table 1. Comparison of farmer's practice Vs. improved practice of sorghum for green fodder during 1989-91.

Treatment	Year			Mean
	1989	1990	1991	
	---------- Kg ha-1----------			
FPFO	15856 c	20983 b	15125 b	17321 c
IPFO	23516 b	24083 b	18750 b	22116 b
FPIF	27216 b	28600 b	21875 b	25897 b
IPIF	36716 a	41583 a	26250 a	34516 a
LSD 0.01	8048	11879	6450	4452
C.V.	13.62	18.50	13.62	1612

FPFO - Farmer Practice Without Fertilizer
IPFO - Improved Practice Without Fertilizer
FPIF - Farmer Practice With Fertilizer
IPIF - Improved Practice With Fertilizer

Treatments means in the same colum having same letter do not differ significantly at 0.01 probability level.

In general, the fodder yield of all the treatments were low in 1991 to the yield obtained in 1989 and 1990. This might be duue to less precipitation during the month of July (Table -5), which delayed germination and stand establishment. The genetic potential of improved varieties was favourable as compared to local varieties as observed in various studies (Sartaj et al, 1984, Shakoor and Khaliq 1989; Khan et al 1989). On over all, average green fodder yield was also significantly higher in fertilizer treatments compared to without fertilizer treatment whether FP or IP. Application of fertilizer added 50% more fodder yield than no fertilizer treatments. Observations were in accordance with finding or Rajpuit et al 1983; Shuka et al 1968 and Rafiq and Afzal 1988.

Dry-Stalk yield

Data showed that full package of technology of attained maximum dry stalk yield (8202 kg ha^{-1}) followed by farmer's practice with fertilizer and improved practice with out fertilizer. The lowest yield (3253 kg ha^{-1}) was recorded in case of farmer without fertilizer (Table 2). Similar trend was noticed in each year, however the FPFO yield of 2517 kg ha^{-1} was much lower in 1991 compeared to corresponding yield during 1989 and 1990. This might be due to uneven and eratic rainfall during early growth stages (Table-5). Average coefficient of variation (C.V.) for the experiment was 15.11 while this was 20.66 during 1991 which is higher than CV of year 1989 and 1990. Present finding revealed the significant of genetic potential of improved cultivars and dry matter yield increased consistently with the increase of nitrogenous fertilizer (Chandravanshi and Singh, 1975; Joshi and Upadhyay, 1977).

Table 2. Comparison of farmer's practice Vs. improved practice of sorghum for dry-stalk during 1989-91.

Treatment	Year			Mean
	1989	1990	1991	
	---------- Kg ha-1----------			
FPFO	3856 c	3387 d	2517 b	3258 c
IPFO	6380 b	6487 c	3150 ab	5339 b
FPIF	6824 b	6936 b	4129 ab	5963 b
IPIF	9633 a	10180 a	4796 a	8202 a
LSD 0.01	2474	1429	1693	903
C.V.	16.69	10.28	20.66	15.11

FPFO - Farmer Practice Without Fertilizer
IPFO - Improved Practice Without Fertilizer
FPIF - Farmer Practice With Fertilizer
IPIF - Improved Practice With Fertilizer

Treatments means in the same colum having same letter do not differ significantly at 0.01 probability level.

Grain yield

The grain yield data showed significant difference among treatment means at 0.01 probability level (Table 3). Maximum grain yield was obtained by IPIF that was 1201 kg ha^{-1} followed by FPIF and IPFO during each year. Bhosale et al, (1983) reported higher grain yield from improved sorghum variety compared to local variety. Similarly, fertilizer treatments gave significantly higher grain yield than non-fertilizer treatments (Rajput et al., 1983; Shakoor and Khaliq, 1989 and Chaudhry et al, 1984). Over all average indicate that the lowest grain yield of 538 k ha-1 was recorded with farmer's practice without fertilizer compared to all other treatments. Low grain yield obtained during 1990 was due to uneven and erratic (Table-5) especially in the month of July which affected pollination process. It is evident from the results that random selection of farmers as replication was homogenous (Table-4). Therefore, non-significant results were obtained for green fodder, dry-stalk and grain yield. Year alone and treatment along were significant at 0.01 probability level for all agronomic characteristics while year x treatment interaction was non-significant for green fodder and grain yield and significant for dry-stalk yield (Table-4).

Impact of new echnology

An impact study was conducted to see the farmer response regarding adoption of technology. This was observed that farmers were more enthusiastic towards replacing local variety with improved variety. The new technology seems to have been compatible in the existing cropping system and reulted in increased production (Hudges and Veen, 1990). However, due to financial constraints, they were reluctant to utilize other inputs i.e. fertilizer and cultural practices (Chatha et al, 1994).

Economic analysis

A separate analysis for green fodder and dry-stalk+grain was done because farmers utilizer some portion of crop that was planted purely for green fodder (40%) and remaining (60% for dry-stalk as well as grain purposes. The green fodder practice was determined as farm gate level after deducting all charges encured on loading/unloading and transportation. These prices were of mid season to avoid early and late season high fodder prices. Fodder is mostly surplus during crop sea-

Table 3. Comparison of farmer's practice Vs. improved practice of sorghum for grain yeild during 1989-91.

Treatment	Year			Mean
	1989	1990	1991	
	---------- Kg ha-1----------			
FPFO	640 c	420 d	553 c	538 c
IPFO	972 b	607 c	666 c	748 b
FPIF	1007 b	742 b	862 b	870 b
IPIF	1630 a	1085 a	1159 a	1201a
LSD 0.01	316	116	148	126
C.V.	13.80	7.07	7.97	13.50

FPFO - Farmer Practice Without Fertilizer
IPFO - Improved Practice Without Fertilizer
FPIF - Farmer Practice With Fertilizer
IPIF - Improved Practice With Fertilizer

Treatments means in the same colum having same letter do not differ significantly at 0.01 probability level.

Table 4. Fvalues and significance levels of production factor and interactions for the year 1989-91.

Source	Green Fodder	Dry stalk	Grainyield
Farmer/Replication	1.41 NS	1.47 NS	0.20 NS
Year	14.22 **	59.63 **	25.42 **
Treatment	14.68 **	69.64**	71.96 **
Year x treatment	1.43 NS	4.69**	0.71 NS
C.V.	16.12	15.11	13.50

** Significant at 0.01 probability level
NS Non-significant

son and prices are low. Therefore, farmers store sorghum as dry-stalk for lean period especially from November to January. They feed this stord stalk to their animals as well as to get high price of surplus fodder from nearby major fodder market. Maximum net benefit of Rs 5311 ha^{-1} was obtained from improved practice with fertilizer through green fodder (Table -6). It was followed by farmer's practice with fertilizer (Rs 3934 ha^{-1}) and improved practice without fertilizer (Rs 3678 ha^{-1}). Lowest net benefit was recorded with farmer's practice without fertilizer (Rs 3059 ha^{-1}). Marginal rate of return (MRR) from green fodder was 188%, 52% and 417% among IPFO and FPFO, FPIF and IPFO, IPIP and FPIF, respectively. While MRR from dry-stalk+grain yield were obtained 392%, 27% and 509% from IPFO and FPIF and IPFO, IPIF and FPIF, respectively (Table -7). The shape of the net benefit curve indicates that the marginal rate of return going from FPFO to IPFO is 188%, well above the minimum. Therefore, treatment IPFO is certainly a worthwhile alternative alternative to the farmers's practice. The marginal rates of return from the treatment FPIO to treatment FPIF is only 52% and below the minimum. Treatment FPIO can; therefore, be eliminated from consideration. In such cases, were the MRR between two treatments falls below the minimum, it is necessary to eliminate the treatments that are unacceptable and recalculate a new marinal rate of rate of return. New marginal of return calculated between treatment IPFO and treatment IPIF, is (5311-3678/1523-700 = 198%), which is above the rate of return. Therefore, treatment IPIF, is (5311-3678/152-700= 198%), which is above the rate of return. therefore, treatment IPIF would have been the treatment (Fig-1). Similar trend in the net benefit curve of dry-stalk+grains has been shown in Fig-1.

Table 5. Mean monthly rainfallduring the growing season and its deviation from the normal (1989-91).

	Year					
Month	1989	Deviation	1990	Deviation	1991	Deviation
May	19	-20	00	-39	49	+10
June	29	-34	84	+21	12	-51
July	210	+33	212	+35	59	-118
August	128	-83	328	+117	223	+11
September	38	-27	69	+4	147	+82
Season	424	-131	639	+138	490	-66

Source Water Resources Research Institute, NARC, Islamabad.

Table 6. Partial Budget; farmer's practice and improved productioin technology of sorghum from 1989-91.

Character	Treatment			
	FPFO	IPFO	FPIF	IPIF
Average Yield (Kg ha^{-1})				
Green Fodder Yield	17321	22116	25897	34516
Dry-stalk	3253	5339	5963	8203
Grain yield	538	748	870	1201
Adjusted Yield (Kg ha^{-1})				
Green Fodder Yield	15589	19904	23307	31064
Dry-stalk	2927	4805	5366	6278
Grain yield	484	673	783	1080
Gross Field Benefits (Rs ha^{-1})				
Green Fodder	3429	4378	5127	6834
Drystalk+Grain yield	3051	4704	5332	7343
Cost of seed (Rs ha^{-1})	240	400	240	400
Cost of labor to plant (Rs ha^{-1})	130	300	130	300
Cost of fertilizer (Rs ha^{-1})	000	000	793	793
Cost of labor to apply (Rs ha^{-1})	000	000	30	30
Net cost that vary (Rs ha^{-1})	370	700	1193	1523
Net Benefits (Rs ha^{-1})				
Green Fodder	3059	3678	3934	5311
Drystalk + Grain yield	2711	4004	4139	5820

Price variation was adjusted by talking average of three years.
FPFO - Farmer Practice Without Fertilizer
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Table 7. Marginal analysis, farmer's practice and improved production technology of sorghum during 1989-91.

Treatment	Costs that vary	Marginal Costs	Net-benefits	Marginal net-benefits	Marginal Rate of return
	---------- Rs ha-1----------				
Green Fodder					
FPFO	370	330	3059	619	188
IPFO	700	493	3678	256	52
FPIF	1193	330	3934	1377	417
IPIF		1523		5311	
Dry-stalk+Grain					
FPFO	370	330	2711	1293	392
IPFO	700	493	4004	135	27
FPIF	1193	330	4139	1681	509
IPIF		1523		582	

FPFO - Farmer Practice Without Fertilizer
IPFO - Improved Practice Without Fertilizer
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IPIF - Improved Practice With Fertilizer

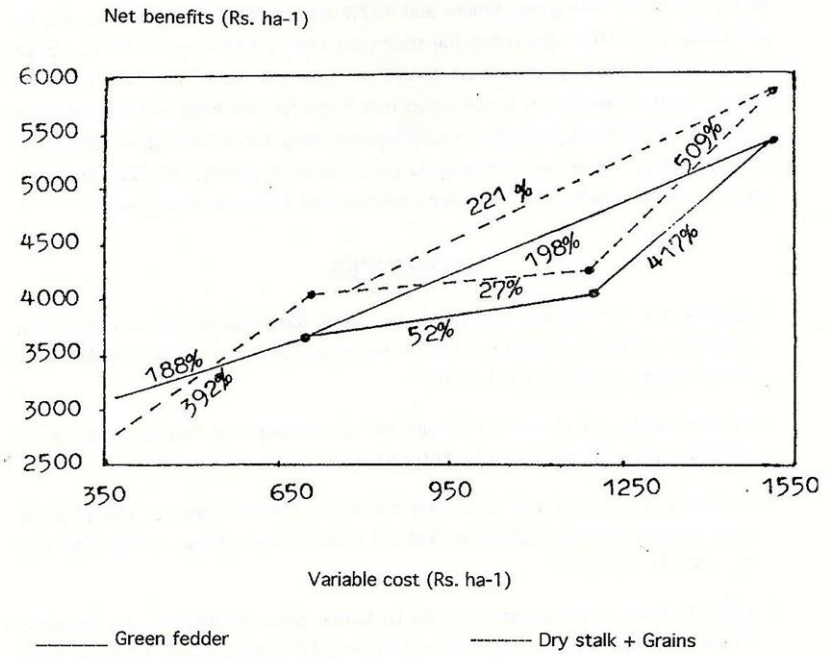

Figure 1. Net benefits curve for sorghum green fodder and dry stalk plus grain yield, 1989-91.

In general, it was observed that improved production technology significantly produced higher fodder as well as dry-stalk and grain yield compared to farmer's practice. Therefore, improved production technology should preferably be incorated in the vast representative domain of medium rainfall zone of Pothwar tract. It is eviden from the marginal rate of return that the addition of each component of improved production technology into farmer's significantly raised the farmer income. Empirial evidence have shown that for the majority of situations the minimum rate of return agreeable to farmer will be between 50-100%. If a change in technology offers a return above 100%, it would be safe to recommend it in most cases (CIMMYT, 1988). Recent study revealed that by the addition of ferttilizer gave MRR 188% and 417% with green fodder and 392% and 509% with dry-stalk+grain, respectively. Even after eliminating the treatment FPIF is 198% and 221% for green fodder and dry-stalk+grains, respectively, which is still higher than the minimum rate of return. Therefore, it is concluded that if the farmers have certain consraints to adopt full improved production technology still they can achieve good rate of return by adding one or two components (i.e., improved variety, fertilizer, line sowing etc.) by considering their resource structure and livestock requirements.

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مقارنة بين معاملة المزارع والمعاملات الزراعية المحسنة للذرة الرفيعة تحت ظروف الأمطار المتوسطة في باكستان

شفيق زاهد، منصب علي، عثمان مفتي، عظيم بهاتي

مركز البحوث والتدريب فى الأرز ـ سخا ـ كفر الشيخ ـ مصر.

يعتبر الماء هو العامل المحدد لأنتاجية المحاصيل في المناطق المطرية، وقد أجريت هذه الدراسة لمقارنة المعاملات الزراعية التي يتبعها المزارع بالمعاملات الزراعية المحسنة لمحصول الذرة الرفعية كمحصول علف أخضر وكذلك محصول الحبوب وتقدير العائد الاقتصادي من تطبيق هذه المعاملات وقد تم مقارنة أربعة معاملات منها معاملتان تمثلان معاملات المزارع والمعاملتان الأخريان تمثلان المعاملات الزراعية المحسنة مع أضافة أو عدم أضافة السماد، وقد أجريت الدراسة في حقول المزارعين خلال الفترة من ١٩٨٩ – ١٩٩١ ومعدل السماد المستعمل هو ٥٧ : ٥٧ نيتروجين : فوسفور كجم للهكتار. وقدر محصول العلف الاخضر ومحصول السيقان الجافة ومحصول الحبوب، وكانت علي الترتيب ٣٤٥١٦، ٨٢٢، ١٣٠١ كجم للهكتار للمعاملات الزراعية المحسنة يليها في الانتاج معاملات المزارع مع أستخدام السماد ثم المعاملات الزراعية المحسنة بدون أستخدام السماد. وكانت أقل القيم المتحصل عليها هي ١٧٣٢ ، ٨٢٣٥، ٥٣٨ كجم للهكتار، نتجت من تطبيق معاملات المزارع بدون أستخدام السماد، للمحصول الاخضر والسيقان الجافة ومحصول الحبوب علي الترتيب.

وقد أظهر التحليل الأقتصادي المبدئي أن أضافة السماد المزارع وتطبيق المعاملات الزراعية المحسنة مع التسميد أعطيا عائد أقتصادي قدره ١٨٨٪ ، ٤١٧٪ للعلف الاخضر الناتج و ٣٩٢٪ ، ٥٠٩٪ للسيقان الجافة مع محصول الحبوب وعند أستبعاد معاملات المزارع مع التسميد من منحني الربح كان العائد الاقتصادي من تطبيق المعاملات الزراعية المحسنة مع التسميد أو بدونه هذه النتائج يمكن التوصل الي أستنتاج أن المزارع يمكنه الحصول علي عائد أقتصادي جيد عند تطبيق المعاملات الزراعية المحسنة سواء بأستخدام التسميد أو بدونه.