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Factors Affecting The Yield of Sunflower in the Province of Punjab (Pakistan)

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Abstract: Pakistan spends major chunk of its foreign exchange reserves on the import of edible oil due to poor domestic base of oilseed production. Considering bleak economic condition of Pakistan, it is very essential to save forex reserves by enhancing domestic oilseed production. Among various types of oilseeds grown in the country, the sunflower, a non-traditional oilseed has the potential to bridge the gap that exists between the domestic demand and supply due to its high oil contents and agronomic suitability to the climatic conditions of Pakistan. This research article attempts to investigate the factor affecting the yield performance of sunflower in the province of Punjab (Pakistan). A Cobb-Douglas type of function has been employed for estimation purpose.

Key words: Sunflower, Factors, Yield, Cobb-Douglas

Introduction

Oilseed sector, due to ever increasing consumption of edible oil, has attained critical importance in the economy of Pakistan. The consumption of edible oil rose from 0.3 million to 1.7 million tonnes during the last two decades. Total requirement of the edible oil in 1998-99 was 1.9 million tonnes, of which only 0.6 million tonnes (29 percent) came from local production while remaining 1.3 million tonnes (71percent) were imported (Economic Survey of Pakistan 1999-2000).

Pakistan spends more than Rs. 40 billions on imports of edible oils alone every year. The import bill, which was Rs. 2.3 billion in 1979-80, has gone up to Rs. 40.5 billion (or US $ 788 million) in 1998-99 showing an increase of 18 times in just 19 years. This is almost 10 percent of our total import bill (Husain, 2000).

In Pakistan, edible oil is extracted from conventional and non-conventional oilseeds. Cotton, rapeseed, mustard, groundnut, and, sesame are conventional oilseed crops and have been grown traditionally in Pakistan. Non-conventional crops such as sunflower, soybean, and safflower were introduced in mid sixties during the era of green revolution but area under these crops is still very small (Badar, 2000).

Sunflower was introduced in Pakistan in the early 1960's. Since then it is being cultivated, but on a limited scale. Earlier, it has been grown by the progressive farmers but now it is being cultivated by the conventional and small farmers as well (Khan, *et al*, 1999).

Sunflower has attained an eminent position in the agriculture of Pakistan as nature has bestowed it with some special characteristics. Sunflower crop can be grown twice a year i.e., in spring as well as in winter season. It contains about 38-45 percent oil contents and 20 percent protein. Its oil is of very high quality and requires little refining. Agronomically, it has a wide range of adaptability. Soil and climatic conditions of Pakistan are quite congenial for its cultivation. It is a short duration crop maturing in 90 to 110 days and is well adjusted to the cropping pattern of the country. It can be grown successfully both in irrigated as well as barani (rainfed) areas (Naeem, 1991).

Although, there is a clear upward trend in the sunflower production in the country but yield per hectare in Pakistan is far less than the yield in other countries. Highest yield per hectare of sunflower in the world in 1996-97 was 2288 kg obtained in Switzerland whereas, in Pakistan yield per hectare was 1302 kg (F.A.O., 1998). However, under favourable conditions at experimental stations in Pakistan, seed yields as high as 2500 kg / ha have been obtained (Hatam *et al*, 1994). So, there is wide gap between the potential yield of sunflower and yield actually obtained in the field in Pakistan Therefore, the objective of this study was to identify those factors, which affect the yield of sunflower.

Materials and Methods

Primary data used in this study were collected in September, 2001 from tehsil Melsi of district Vehri and tehsil Daska of district Sialkot. These tehsils were selected based on their production statistics and area under sunflower. From each tehsil five villages were selected representing average agronomic conditions. Seven farmers from each village were interviewed. A sample size of 35 respondents was selected from each tehsil. Total sample thus comprised of 70 farmers from both the districts. A well- designed, comprehensive and pre-tested questionnaire was used to collect required data from both the districts.

The data was analyzed through computer package i.e., Statistical Package for Social Scientists (S.P.S.S). Regression analysis was used to identify production factors affecting the yield of sunflower. Cobb-Douglas type of function was visualized for this data. The generalized form of the model is as under:

$$Y = A_o \Pi X_i^{\beta_i} e^{\Sigma \alpha_i D_i + \mu_i}$$

This equation can be linearized in the following way.

$$Ln\ Y = \beta_o + \Sigma\ \beta_i Ln\ X_i + \Sigma\ \alpha_i\ D_i + \mu_i$$

Model : The yield of sunflower is affected by several factors. Data was analyzed with Cobb-Douglas function to observe the effects of different factor on sunflower yield. Following equation was formed for factors affecting the yield of sunflower in Punjab as under'

$$Ln\ Y = \beta_o + \beta_1 X_1 + \beta_2 Ln\ X_2 + \beta_3 Ln\ X_3 + \beta_4\ Ln\ X_4 + \beta_5\ Ln\ X_5 + \alpha_1\ D_{1\ +}\ \alpha_2\ D_2 + \mu_i$$

Where;

1. Y = Yield of sunflower in maunds per acre
2. β_o = Constant term (Intercept),
3. X_1 = Number of Ploughings,
4. X_2 = Seed Rate (Kg / Acre),
5. X_3 = Number of Irrigations,
6. X_4 = No. of bags of Urea,
7. X_5 = No. of bags of DAP,
8. D_1= Dummy variable for sowing method. (1 stands for the use of Drill sowing and 0 for Broad cast sowing.)
9. D_2= Dummy variable for Pest Attack. (1 stands for the Pest Attack and 0 for absence of pest attack.)

Results and Discussion

Estimated model for factors affecting the yield of sunflower: The yield of sunflower is affected by several factors. Cobb-Douglas type of model was considered appropriate to analyze the effects of various factors on the yield of sunflower. As result of analysis, following Cobb-Douglas type of function was estimated for sunflower production in the area.

$$Ln\ Y = \underset{(0.2134)}{2.9156} + \underset{(0.0553)}{0.1741}\ X_1 - \underset{(0.1737)}{0.5704}\ X_2 + \underset{(0.0678)}{0.2020}\ X_3 + \underset{(0.0168)}{0.1037}\ X_4 + \underset{(0.01167)}{0.0758}\ X_5 + \underset{(0.0356)}{0.07154}\ D_1 - \underset{(0.0411)}{0.1691}\ D_2$$

R-Square	=	0.858843,
Adjusted R-Square	=	0.842906,
Durbin-Watson Statistics	=	1.56741,
Observations	=	70

of this elasticity coefficient is 0.1741, which means that one percent increase in this variable causes an increase in the yield of sunflower by 0.1741 percent. This was significant at one percent level of significance (Annexure).

Annexure: Summary output of regression analysis

	Coefficients	Standard Error	t-Stat	P-value	Lower 95%	Upper 95%
Intercept	2.915587	0.213392	13.66305	2.31E-20	2.489023	3.342151
Ploughings (X_1)	0.174084	0.055331	3.14623	0.002541	0.063479	0.284689
Seed Rate (X_2)	-0.57043	0.173681	-3.28436	0.001683	-0.91761	-0.22325
Irrigation (X_3)	0.202038	0.067815	2.979238	0.004122	0.066477	0.337598
Urea (X_4)	0.103724	0.01675	6.192561	5.25E-08	0.070241	0.137206
DAP (X_5)	0.075776	0.011665	6.495763	1.59E-08	0.052457	0.099095
Sowing Method (X_6)	0.071537	0.035569	2.011194	0.048658	0.000435	0.142639
Pest Attack (X_6)	-0.16909	0.041104	-4.11364	0.000117	-0.25125	-0.08692

Multiple R	0.926738
Standard Error	0.13739
R-Square	0.858843
Durbin-Watson Statistics	1.56741
Adjusted R Square	0.842906
Observations	70

Seed rate (X_2): The results indicates that coefficient of seed rate of sunflower had negative sign indicating that the seed rate has negative relationship with the yield of sunflower. The value of coefficient was - 0.5704 and it was significant at one percent. The coefficient indicates that by one percent increase in seed rate of sunflower beyond recommended rate, the yield of sunflower decrease by 0.5704 maunds per acre. Recommended rate of sunflower seed for sowing is 2-3 kg per acre. Increase in seed rate beyond this range results in a high density of plants, i.e., more than desired level. It results in increased competition among plants for nutrients and water that leads to decline in yield per acre (Annexure).

Number of irrigations (X_3): The value of total number of irrigations has positive relationships with the yield of sunflower. Its value is 0.202 and is also significant at one percent level. The result of this variable implies that one percent increase in irrigation tends to increase the yield by 0.202 percent (Annexure).

Number of bags of urea (X_4): Another independent variable in this analysis is the urea fertilizer, which contains the active ingredient of nitrogen 46 percent. The coefficient for this variable is positive and its value

Explanation of the model: The R-Squared statistics indicates that the model explains 85.8843 percent of the variability in Y variable. The adjusted R-Squared statistics, which is more suitable for comparing models with different numbers of the variables, is 84.2906 percent. The standard error of the estimates shows the standard deviation of the residuals to 0.13739. The Durbin-Watson (DW) statistic tests the residuals to determine if there is any significant correlation based on the order in which they occur in the data. Since the DW value is the greater than 1.4, there is probably not any serious autocorrelation in the residuals (Table). The impact of various variables on the yield per acre of sunflower explained by the model is as under.

Number of ploughings (X_1): Land preparation plays an important role in obtaining high yield per acre. Regression analysis shows that elasticity coefficient of number of ploughings has positive sign indicating that impact of ploughings on the yield is positive. The value is 0.1037, which means that one percent increase in urea fertilizer causes an increase in the yield of sunflower by 0.1037 percent. This variable is highly significant at one percent level (Annexure).

Number of bags of DAP (X_5): The value of coefficient for DAP (Di Ammonium phosphate) fertilizer is 0.0758. It is also significant at one percent significance level. It implies that a one percent increase in the use of this fertilizer tends to increase the yield of sunflower by 0.0758 percent (Annexure).

Sowing method (D_1): The sowing method was used as dummy variable in this analysis. The coefficient of sowing method is 0.0715. It shows that the use of drill sowing affects the yield of sunflower significantly. The coefficient is significant at 0.04 percent. The use of drill for sowing increases the yield of sunflower 0.0152 percent (Annexure).

Pest attack (D_2): The second dummy variable used in this analysis was pest attack. The coefficient for this variable is negative and is -0.1691. This means that pest attack has negatively affects the yield of sunflower as these pests destroys significant portion of the yield per acre of the sunflower. The coefficient shows pest attack decreases the yield of sunflower by 0.1691 percent. It is significant at one percent level (Annexure).

Conclusion

Comparative analysis of the coefficient of the model points out that land preparation, seed rate, irrigations, fertilizers (both urea and DAP), and drill sowing affects the yield of sunflower positively. Whereas, higher seed rate (more than the recommended) and pest attack significantly reduces the yield of sunflower.

Sunflower among the non-traditional oilseed crops has the potential to the bridge the gap between demand and supply of oilseeds in the country owing to its certain characteristics. So far, full potential of sunflower crop has not been realized. Nonetheless, few guidelines are presented as under that may prove helpful for the planners interested in increasing the production of sunflower in the country.

Extension department should provide technical guidance to the farmers relating to the production technology. As majority of farmers were not fully aware of the production technology of the sunflower therefore were using more seed than the recommended one. Printed material should also be provided to them. Attack of pests is one of the major factors contributing towards the decline of per acre yield of the sunflower. Concerned departments should help the farmers in this regard by suggesting proper methods and techniques in vogue for the control of pests to avoid yield losses.

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