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Effect of Different Organic Manures on the Yield of Safflower Cultivars

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Abstract:

Pakistan is facing harsh shortfalls of edible oils. Therefore, a field experiment was conducted to check yield potential of various cultivars grown under organic farming and to determine N uptake and crop apparent N recovery of the manures by safflower. Organic fertilizers were applied at the rate of 80 kg N/ha, FYM and Poultry manure were applied. Results showed that Soil N_{min} *content was considerable increased to 25% and 24% in FYM and PM after their application as compared to its initial soil* N_{min} *and reduced after*

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harvesting of crop. Soil K also boosted after manure application highest increase 78% noticed in PM followed by FYM which was 75% and remain in increasing trend after harvesting of crop. Soil pH increased the highest with the average of 0.74 was noticed in PM followed by FYM which was 0.71 as compared to initial soilpH. Line TN-79-683 had highest mean seed yield of 860 kg/ha while BI-20926 had lowest mean seed yield of 481 kg/ha. Highest dry matter yield with the mean of 7817 kg/ha was noticed in TN-79-609, while lowest dry matter yield with mean of 3459 kg/ha was noticed in BI-251289. Harvest index was not significant different among treatments, but among cultivars/lines there were great differences. Highest harvest index of 14% was recorded from line BI-250538 followed by line TN-79-683 which was 12.2%. PM application significantly increased seed yield by 31% and dry matter yield by 20% as compared to the control.

Key words: Organic Manures, Safflower Cultivar, Seed yield, Nitrogen Uptake

1. INTRODUCTION

Pakistan is facing a severe shortfall of edible oils. About 70% of the domestic requirements are met through imports which makeit the fifth largest importers of edible oil from the other countries. Since early 1970, its import increased at the rate of 12.5% annually and this tendency will further not only continue but will also be improved with increase in population. However, efforts have been made in recent couple of decades to increase local production of oilseed crops [1]. The area under oilseed crops during 1990-1991 was 0.51 million ha with the production of 0.40 million tons, which is slightly improved during 2012-2013 to 0.60 million ha producing 0.58 million tons of edible oil [2]. However, still there is great need to conduct research to identify alternative oilseed crops suitable for cultivation to fulfill the need of edible oil in Pakistan. One of the options can be to grow safflower, which can give a superior oilseed production even in dry lands of the country. Safflower (*Carthamustinctorius L.*) is a member of the family *Compositae* or *Asteraceae*, cultivated mainly for its seeds, which are used as edible oil production. The crop was grown for its flowers, used for coloring and flavoring foods and making dyes, especially before cheaper aniline dyes became available [3]. For the last few decades, the crop has been cultivated mainly for oil extraction from its seeds [4]. Seed oil content is between 35 and 50% [5]. Safflower oil is flavorless and colorless, and similar in composition to sunflower oil [6]. Safflower has spiny and spineless varieties. Spiny varieties have spines on the leaves and the modified leaves associated with flower heads. Generally, varieties with no spines have been lower in oil content than spiny types. Safflower represents an important oil crop internationally and may have a certain production potential under various managements, particularly in organic farming where low nutrient requirement by the crop is highly welcomed [6]. Safflower can play a large role in providing the oil supplies of the country duet o the unique and desirable properties of its oil such as high in unsaturated fatty acid. Besides, its seed cake can be used for the production of meal as a dietary supplement for livestock. Safflower oil is thought to be one of the highest quality vegetable oils, containing oleic acid and linoleic acid. There are two types of safflower; high linoleic types that have an approximate range of linoleic acid from 3.1% to 88.8%, and high oleic types with an approximate range of oleic acid from 3.9% to 90.6% [7]. Safflower can grow on poorly fertile soil and rainfed conditions because of its unique characteristics such as drought, cold stress and salinity tolerance [8]. It has been reported that vegetable oil composition is affected by the source of nutrient inputs whether it is organic or inorganic. Safflower cultivation under organic farming with slow nutrient release can improve seed oil content as well as oil yield[9].Besides, application of organic fertilizer such as farmyard manure (FYM) and poultry manure (PM) are expected to improve nutrient uptake as well as apparent nitrogen (N) recovery of safflower and consequently increase the productivity of oil. In recent years, public concerns have been raised about the potential environmental pollution made by excessive use of chemicals fertilizers in Pakistan. These along with the concerns over the sustainable agriculture have created an interest in using organic fertilizers [10]. Besides, cost of inputs of major nutrients through chemical fertilizers is increasing, so using organic farming system is the need of present agriculture. The slow release of nutrients from repeated application of FYM and PM provides better soil physical and chemical environment [11]. Therefore, the use of organic manures is suggested in the present study because is easily available, can boost the crop production to some extent and keep soil fertile. Safflower is used as a feed for livestock [12]. It has been reported that use of safflower seed cake as livestock feed can improve the content of health promoting fatty acid in their body and milk [13]. However, potential organic safflower seed cake as livestock feed is still to be tested in Pakistan. It is hypothesized that safflower grown well under organic manure in rainfed conditions and will have good seed yield as well as oil and seed cake quality, because organic fertilizer can improve nitrogen (N) availability to plants which will have a significant effect on both safflower yield and oil quality. Therefore, the objectives of this study are to evaluate the yield potential of various safflower cultivars grown under organic farming in rainfed conditions and to determine N uptake and crop apparent N recovery of the manures by safflower.

2. MATERIALS AND METHODS

The study was carried out at University Research Farm, Chakwal road, Koont situated at s longitude 72.855° E, latitude

32.930° N and has altitude of 760 m from sea level. The temperature of the region increasing up to 40°C during summer, but in winter it is cold and may range between -4 to 25°C. Precipitation in the region greatly depends on seasonal rainfall, which fall irregularly throughout the year and frequent storm occur in monsoon.

2.1. Experimental Details

2.1.1. Field Preparation

Prior to conducting of experiment, field was prepared by cultivator. Good seedbed was prepared after planking. Poultry manure (PM) and Farmyard manure (FYM) on the basis of 80 kg nitrogen (N) per hectare were mixed in top 10 cm of the arable field one week earlier than sowing of the crop. The plot size used in the experiment was 2 m x 3m. Controls (untreated) were also kept for each treatment in the experiment.

2.1.2. Experimental Design

Experiment was laid out in split- plot design with three replications. Seven safflower cultivars were sown one week after manure incorporation during Rabi season 2015-2016. Each plot had ten rows of plants with row space of 30cm. Manual removing of weeds were done at the vegetative stage of the crop.

2.1.3. Safflower Cultivars/Lines

- Thori-78 (Check)
- BI-209296
- BI-250538
- BI-251289
- Leed-00 (Check)
- TN-79-609
- TN-79-683

2.1.4. Organic Manures

- Control (unfertilized)
- Poultry Manure (PM)
- Farmyard manure (FYM)

2.1.5. Chemical Characteristics of PM and FYM Used in the Experiment

Organic manures were analyzed for nitrogen content (N) and pH before their application and applied at the rate of 80 kg N/ha. N content of PM was 2.98% and it's was pH 7.63, While FYM have 1.75% and pH 7.58. Both manures were applied at the rate of 80 kg N/ha.

2.1.6 Soil Sampling and Analysis

Compound soil samples were taken (i) prior to application of manure (ii) after cultivation of safflower cultivars and after harvesting. Five soil samples were taken randomly from each plot at a depth of 0-30cm and mixed to get a compound sample. The air-dried sample were analyzed for the below mentioned parameters in the laboratory of department of soil science at PMAS-Arid Agriculture University Rawalpindi.

2.2. Soil parameters

2.2.1. Measurement of Soil pH

Soil pH was measured by preparing soil and water solution with the ratio of 1:2, respectively. For this purpose, 10g of dry soil was taken into a beaker and 20ml of distilled water was added. Solution was mixed properly with a glass rod and stirring was repeated after every 10 minutes for three times. After half hour, combined electrodes of pH meter were inserted in the solution and reading was recorded (McLean *et al.*, 1982).

2.2.2 Measurement of Soil Mineral Nitrogen (N_{min}) and Available Phosphorus (P)

Ammonium bicarbonate-diethylene triamine penta acetic acid (AB-DTPA) method was used for the determination of mineral nitrogen (NO_3^-N + NH_4^+-N), and available phosphorus (P) in soil (Soltanpour and Workman, 1979).

2.2.3. Preparation of AB-DTPA solution

A 0.005M AB-DTPA solution was prepared by dissolving 79.1 g of ammonium bicarbonate (AB) and 1.97g of diethylene triamine penta acetic acid (DTPA) in 800ml of deionized water. The pH was adjusted to 7.6 with 6N hydrochloric acid (HCl). The solution was diluted to 1L volume by adding distilled water.

2.2.4 Determination of Mineral Nitrogen (N_{min})

Twenty grams of soil was taken in a conical flask and 40 ml of AB-DTPA solution was added. Subsequently, soil solution was shaken for 15 minutes. After shaking the solution were kept in the storage bottles for analysis of N_{min}, i.e. NO_3^--N and NH_4^+-N.

a) Determination of NO_3^--N

One milliliter of each of AB-DTPA soil extract andNO_3^--N standards solutions of concentrations 0.5, 1.0, 1.5, 2.0, 2.5 and 3.0 mg L^{-1} were taken in separate test tubes. Subsequently, 3ml sodium hydroxide solution, 3ml copper sulfate solution and 2ml hydrazine sulfate solution was added in each test tube. The test tubes was shaken on test tube shaker and then heated in a water bath (38°C) for 20 minutes. Next, the test tubes was removed from water bath and 3ml of color developing reagent for NO_3^- was added and mixed on test tube shaker. After 20 minutes NO_3^- -N was determined by reading the absorbance at 540nm wavelength using a spectrophotometer. The concentration of NO_3^-N in the samples was calculated as:

NO_3—N (mg L^{-1}) = NO_3^- -Nin mg L^{-1} in extract × dilution factor

b) Determination of NH_4^+-N

In separate test tubes, 3.5 ml of each AB-DTPA soil extract and NH_4^+-N standards of concentration 0.5, 1.0, 2.0, 3.0 and 4.0 mg L^{-1} was taken. Afterwards, 4ml of sodium phenate solution and 3ml of sodium hypochlorite solution was added in each test tube. Each tube were shaken on a test tube shaker and then heated in a water bath at 70°C for 20 minutes. The tubes were removed from the shaker and after 20 minutes NH_4^+-N was determined by reading the absorbance at 660nm wavelength using a spectrophotometer (Winkleman *et al*., 1986). The concentration of NH_4^+-N in the samples was calculated as:

NH_4^+-N (mg L^{-1}) = NH_4^+-N in mg L^{-1} in extract × dilution factor

2.2.5. Available Phosphorus (P)

For determination of available P, 10g soil was taken in a 250 ml flask and 20 ml of AB-DTPA solution was added. The flask was shaken for half an hour on a shaker at 250 rpm. The solution was filtrated through filter paper, i.e.Whatman No. 42. Mix reagent solution was prepared by dissolving 12g of ammonium molybdate and 0.291g of antimony potassium tartarate in 800 ml deionized water, subsequently 148ml of concentrated H_2SO_4 was added in this solution. Color developing reagent was prepared by adding 0.739g of ascorbic acid in 140ml of mix reagent solution. A stock solution of KH_2PO_4 was prepared. Standards solutions were prepared from stock solution as follows: 0.5, 1.0, 1.5, 2.0, 2.5 and 3.0 ppm. In test tube 1ml of soil extract, standards and blanks were taken subsequently 9ml of deionized water and 2.5ml of mix reagent was added. Samples and standards were shaken on electric shaker for 10 minutes. Afterwards, samples, blank and standards were analyzed by spectrophotometer at 880nm wavelength. A calibration curve was prepared for standards by plotting absorbance against their respective P concentration. Concentrations of P in the samples were determined by using the standard calibration curve and following formula:

$$P\ (mg\ L^{-1}) = P\ in\ mg\ L^{-1}\ in\ extract \times dilution\ factor$$

2.2.6. Soil Potassium (K)

The K in soil was determined directly from soil extract either by a flame photometer or an atomic absorption spectrometer using potassium hollow cathode lamp. Soil extract was made by taking 10 g air-dry soil (2-mm) into 125 ml conical flask. 20 ml was added extracting solution and shake on the reciprocal shaker for 15 minutes at 180 cycles per minute with flasks kept open. The extract was then filtered through whatman No. 42 filter paper.

The standard solution of potassium containing 0, 5 and 10 ppm.

For determination of K in soil:

$$K\ (ppm) = K\ (ppm\ in\ extract) \times Dilution\ Factor$$

2.3 Determination of plant total nitrogen

Total nitrogen (N) in the plant was determined by Kjeldahl method (Bremner and Mulvaney, 1982). Following steps were done:

a. Digestion

In a digestion tube, 0.5 g of grounded shoot sample were taken and 1.25 g of digestion mixture (K_2SO_4-$CuSO_4.5H_2O$-Selenium powder 100:10:1 w/w/w ratio) and 4 ml of concentrated H_2SO_4 was added. The sample was digested for about 90 minutes at 360°C on digestion block until become transparent.

b. Distillation

After cooling, all the contents from digestion tube were rinsed into distillation flask and 20 ml of 40% NaOH was added in it. Next, 10 ml of 2% boric acid solution was taken in a conical flask and distillate was collected in it to make volume up to 30 ml.

c. Titration

The distillate was titrated against 0.01 N HCl until the light pink color (endpoint) was appeared. Two blank were also be digested, distilled and titrated similarly as the sample. The N content of the samples were determined by using following formula:

%N= (14.0067×[ml of titrant sample – ml of titrant blank]× normality of acid/ weight of sample(g) ×10

2.4. Yield parameters

2.4.1. Seed and Dry Matter Yield (kg/ha)

Among ten rows of each plot eight middle rows were harvested for seed, dry matter (DM) yields. Fresh yield was taken immediately after harvesting while DM yield was determined by drying the samples in sun until constant weight is obtained. Seed and dry matter yield were recorded with an electric scale and converts into the unit of kg/ha.

2.4.2 Harvest Index (%)

Harvest index (HI) was calculated after harvesting of crop using the following formula:

$$\text{HI (\%)} = \frac{\text{Grain yield}}{\text{Dry matter yield}} \times 100$$

2.5. Statistical analysis

For the determination of effect of treatments on the seed yield parameters and on soil characteristics, least significant difference (LSD) tests among means were conducted separately.

3. RESULTS AND DISCUSSIONS

3.1 Results

3.1.1. Temperature and rainfall data during Experimental period

Data regarding mean daily temperature (solid line) and cumulative rainfall (bars) during experimental period is shown in Fig. 1. Solid line indicates that mean daily temperature of 24°C was observed at crop germination stage while gradual decrease occurred afterwards. Average temperature during week 11to 15 of the crop was low, i.e. 15°C. Later on temperature gradually increased and average temperature at the last four weeks of experimental period were high, i.e. 32°C. Maximum rainfall of 70, 57 and 36 occurred during week 13th, 7th and 21th of the period

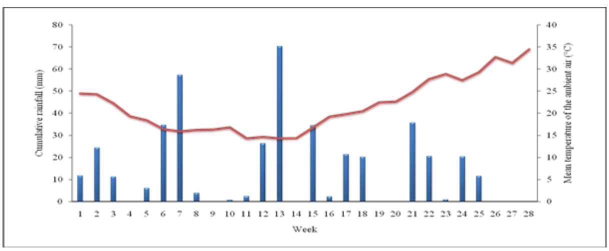

Fig. 1: Weekly average temperature (solid line) and cumulative rainfall (bars) during experimental period

3.2. Chemical characteristics of the soil

3.2.1. Soil Mineral Nitrogen (kg/ha)

Soil mineral nitrogen (N_{min}) boosted after each manure application as compared to initial N_{min} of soil (Fig 1.1). The highest average increase of 25% was observed after application of farmyard manure (FYM) followed by poultry manure (PM) which was 24% relative to initial soil N_{min}. However, decrease of 6% in control was recorded as compared to initial soil N_{min}. The decrease in N_{min} in control might be due to loss of soil N_{min} through volatilization, nitrification, denitrification and leaching as well as uptake by the weeds. On other hand soil N_{min} was reduced in all treatments after harvesting of the crop. The decrease of 28, 21 and 19% was noticed in control, PM and FYM, respectively (Fig. 1.2).

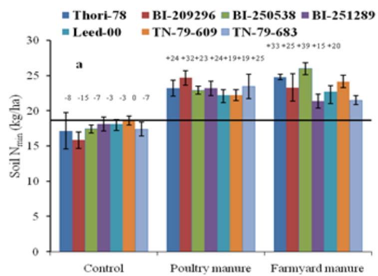

Fig. 1.1: Soil mineral nitrogen (N_{min}) (a) after manure application.

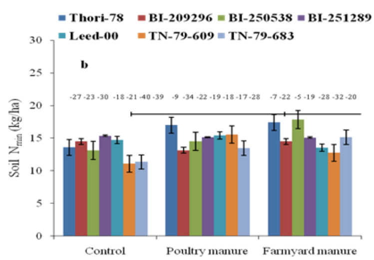

Fig. 1.2: Soil mineral nitrogen (N_{min}) after harvesting of crop.

Error bars represent standard error of the means. Horizontal line on the Fig. represents initial N_{min} value of the soil. Values above each bar represent the percent change (+ve/-ve) in N_{min} as compared to its initial value.

3.2.2. Soil Available Phosphorus (kg/ha)

Data presented in Fig. 2 shows the change (+ve/-ve) in available P (a) after manure application (b) after harvesting of crop as compared to its initial value. The highest increase was observed in FYM with mean of 25% followed by PM which was 23% as compared to initial soil available P (Fig.3).

3.2.3. Soil Potassium (kg/ha)

Soil potassium (K) content was boosted after the manure application (Fig. 5). Highest increase with the mean of 78% was noticed in PM followed by an increase of 75% in FYM treatment as compared to initial soil K. The results are supported by Adeleyeet al. (2010) who also reported an increase in soil K after PM application as compared to control. There were no differences between PM and FYM treatments ($P \leq 0.05$). Data presented in Fig.4.2.3b indicated that the soil K had the increasing trend as it was after manure application. However, increase was lower than before in the manured plots. The highest increase observed in PM followed by FYM which was 31 and 28%, respectively. A decrease of 21% was recorded in control treatment. The little decrease in soil K after harvesting of crop as compared to soil K after manure application (Fig. 4.2.3b) might be due to lower K requirements of safflower compared to its soil supply.

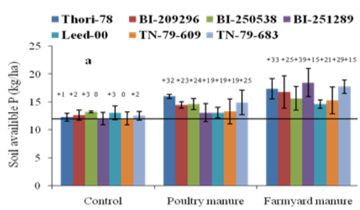

Fig.2: Soil available phosphorous (P) fig 4 after manure application Error bars represent standard error of the means. Horizontal line in the Fig. 5 represents initial P value ofthe soil. Values above each barre present the percent change (+ve/-ve) in available P as compared to its initial value.

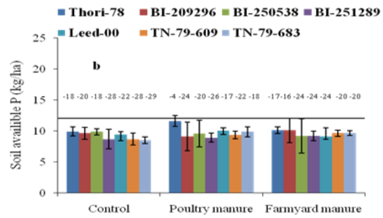

Fig. 3: Soil available phosphorous (P) after harvesting of crop Error bars represent standard error of the means. Horizontal line in the Fig. represents initial P value ofthe soil. Values above each bar represent the percent change (+ve/-ve) in available P as compared to its initial value.

3.2.4. Soil pH

Fig. 6 presents unit change (+ve/-ve) in soil pH (a) after manure application and Fig 7after harvesting of crop relative to its initial value. Unit increase was recorded after each type of manure application as compared to its value before its application. On other hand, data showed that there was an increase in soil pH at the end of the experiment. The highest unit increase with the average of 0.74 was noticed in PM followed by FYM which was 0.71 as compared to initial soilpH. This increase might be due to alkaline pH of both manures, i.e. PM had pH 7.63 and FYM had pH 7.58.

3.3. Yield parameters

3.3.1. Seed Yield (kg/ha)

Data presented in table 4.3 showed that there were significant difference among cultivars/lines and organic fertilizer treatment of Safflower seed yield ($p \leq 0.05$). Results indicate that maximum seed yield with mean of 787 kg/ ha were obtained after PM application followed by the FYM with the mean of 727 kg/ha while the minimum seed yield 546 kg/ha was obtained from control treatment. Results of mean comparison showed that among cultivars there were great variations for seed yield (Table 1). Among various exotic and local cultivars/lines the performance of line TN-79-683 was better than all other cultivars/lines in terms of seed yield. It gave the highest seed yield of 860 kg/ha, While line BI-251289 gave the lowest seed yield of 479 kg/ha

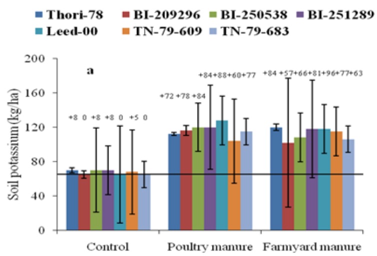

Fig. 4 : Soil potassium (K) (a) after manure application. Horizontal line on the Fig. represents initial K ofthe soil. Values above each bar represent percent change (+ve/-ve) in K as compared to its initial value

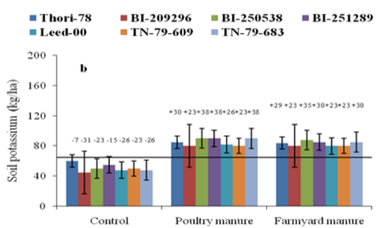

Fig: 5 Soil potassium (K) after harvesting of crop. Error bars represent standard error of the means. . Horizontal line on the Fig. represents initial K of the soil. Values above each bar represent percent change (+ve/-ve) in K as compared to its initial value

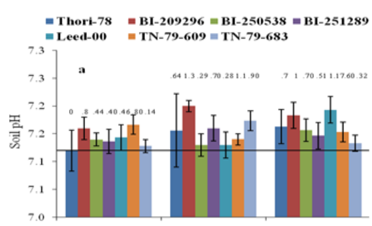

Fig. 6: Soil pH (a) after manure application

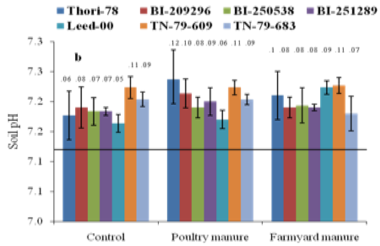

Fig. 7: Soil pH after harvesting of crop

3.3.2 Dry Matter Yield (kg/ha)

Dry matter represents the total amount of above ground biomass including parts of economic importance. Data regarding dry matter yield is shown in Table 2. Highest dry matter yield with the mean of 6964 kg/ha were recorded from PM followed by FYM which was 6720 kg/ha, with no significant differences. Lowest dry matters yield with the mean of 5762 kg/ha were recorded when there was no fertilizer applied (control treatment).

Table 1: Mean seed yield (kg/ha) of safflower cultivars/lines under various organic fertilizers management.

Fertilizer	cultivar /line							Mean
	Thori-78 (check)	Bi-20926	Bi-250538	Bi-251289	Leed-00 (check)	Tn-79-609	Tn-79-683	
Control	608* ghij	366 l	495 jkl	453 kl	617 ghij	568 hijk	713 fg	546 C
Poultry manure	867 cde	561 hijk	941 bc	465 kl	725 efg	871 cd	1077 ab	787 A
Farmyard manure	580 ghi	517 ijk	809 cdef	519 ijk	696 fgh	1118 a	790 def	727 B
Mean	685 B	481 C	748 B	479 C	679 B	852 A	860 A	

*Means followed by different letter(s) in respective column/row differ significantly ($P \leq 0.05$).

LSD ($P \leq 0.05$) for safflower seed yield

Fertilizers= 52, Cultivars/Lines = 89, Fertilizers×cultivars = 138

Table 2: Mean dry matter yield (kg/ha) of safflower cultivars/lines under various organic fertilizers management

Fertilizer	Cultivar/line							Mean
	Thori-78 (Check)	BI-20926	BI-250538	BI-251289	Leed-00 (Check)	TN-79-609	TN-79-683	
Control	6698* def	4792 h	2287 I	6962bcdef	6184 fg	6971 cdef	6439 fg	5762 B
Poultry manure	6817 cdef	5288 gh	6605 ef	6255 fg	7744abcd	8361 a	7918 abc	6964 A
Farmyard	6581 ef	6430 fg	4906 h	7870 abcd	6351 fg	8120 ab	6542 ef	6720 A

manure								
Mean	6699^{B}	5503^{C}	3459^{D}	7029^{B}	6759^{B}	7817^{A}	6966^{B}	

*Means followed by different letter(s) in respective column/row differ significantly (P≤0.05).
LSD (P≤0.05) for safflower dry matter yield
Fertilizer = 461, Cultivars/Lines = 695, Fertilizers× cultivars = 1219.

Lowest dry matters yield with the mean of 5762 kg/ha were recorded when there was no fertilizer applied (control treatment).

3.3.3 Harvest Index (%)

Physiological competence and conversion capacity of crop dry matter into seed (economic) yield can be assessed by harvest index. Superior the harvest index more will be the production efficiency of the crop.

Variance analysis of harvest index Table 3 showed considerable differences among cultivars/lines (P≤0.05). Highest mean for harvest index was recorded from line BI-250538 which was 14% while the lowest harvest index 12% was recorded from line TN-79-683.

Table 3: Mean harvest index (%) of safflower cultivars/lines under various organic fertilizers management

Fertilizers	Cultivar/line							Mean
	Thori-78 (Check)	BI-209296	BI-250538	BI-251289	Leed-00 (Check)	TN-79-609	TN-79-683	
Control	9.2^{hijk*}	7.8^{ijk}	10.8^{efg}	6.5^{k}	9.4^{fghij}	8.1^{ijk}	11.0^{defgh}	9.0^{B}
Poultry manure	12.7^{cde}	10.7^{defg}	14.4^{ab}	7.6^{jk}	9.7^{ghij}	10.7^{efg}	13.6^{cd}	11.3^{A}
Farmyard manure	9.7^{ghij}	8 ijk	16.6^{a}	6.5^{k}	9.9^{defgh}	13.4^{cde}	12.0^{cdefg}	10.8^{A}
Mean	10.5^{C}	8.8^{D}	14.0^{A}	6.9^{E}	9.7^{C}	10.7^{C}	12.2^{B}	

*Means followed by different letter(s) in respective column/row differ significantly (P≤0.05).
LSD (P≤0.05) for safflower harvest index
Fertilizers= 1, Cultivars/Lines = 1, Fertilizers× cultivars = 3

Maximum harvest index with the mean of 11.3% was recorded under FYM application as compared to PM and control which was 10.8% and 9%, respectively. Interaction between Fertilizers×cultivars was significantly higher ($P \leq 0.05$).

3.4. Discussion

Pakistan is facing a severe shortfall of edible oils. About 70% of the domestic requirements are met through imports, which make it the fifth largest importers of edible oil from the other countries. Since early 1970, its import increased at the rate of 12.5% annually and this tendency will further not only continue but will also be enhanced with increase in population. Safflower cultivation can play a vital role in country oil production because it can grow well under organic farming system due to its low nutrients requirement which also lower the cost of production. Results showed that Soil N_{min} content was considerable increased to 25% and 24% in FYM and PM after their application as compared to its initial soil N_{min} and reduced after harvesting of crop. Highest decrease was noticed in PM which was 28% followed by FYM and control. Soil available P content also increased after manure application. The highest increase was observed in FYM with mean of 25% followed by PM which was 23% however, decreased after harvesting of crop in all treatments. Highest mean decrease was observed in control by 23% followed by FYM and PM which was 21 and 19%, respectively as compared to initial soil available P. Soil K also boosted after manure application highest increase 78% noticed in PM followed by FYM which was 75% and remain in increasing trend after harvesting of crop. The highest increase observed in PM followed by FYM which was 31 and 28%, respectively. Soil pH increased after manure application and harvesting of crop the highest with the average of 0.74 was noticed in PM followed by FYM which was 0.71 as compared to initial soi lpH. Line TN-79-683 had highest mean seed yield of 860 kg/ha while BI-20926 had lowest mean seed yield of 481 kg/ha. Highest dry matter yield with the mean of 7817 kg/ha was noticed in TN-79-609, while lowest dry matter yield with mean of 3459 kg/ha was noticed in BI-251289. Harvest index was not significant different among treatments, but among cultivars/lines there were great differences. Highest harvest index of 14% was recorded from line BI-250538 followed by line TN-79-683 which was 12.2%. PM application significantly increased seed yield by 31% and dry matter yield by 20% as compared to the control. Increase in organic matter with the application of organic manures enabled soil environment to hold more moisture, nutrients and better aeration, which had direct effects on uptake of nutrients from the soil. Consequently, significant improvement in seed yield attributes and final seed yield of safflower was noticed. The application of FYM gave high seed yield of 1883 kg/ha as compared to VC, UWC and control which had yield of 1496, 1710 and 1536 kg/ha, respectively [15, 16] the slow release of nutrients from repeated application of FYM and PM provides better soil physical and chemical environment [17]. Safflower cultivation under organic farming with slow nutrient release can improve seed oil content as well as oil yield[18, 19].Besides, application of organic fertilizer such as farmyard manure (FYM) and poultry manure (PM) are expected to improve nutrient uptake as well as apparent nitrogen (N) recovery of safflower and consequently increase the productivity of oil [20]. organic amendments significantly increased seed yield in both cultivars by 48% and 128% through the application of CM and SM as compared to control, respectively [21] Combine application of PM along FYM gave the highest seed yield of 1437 kg/ha, as compared to sole application of PM which had seed yield of 1707 kg/ha and control with 762 kg/ha seed yield [22].

CONCLUSIONS

A field experiment was conducted during winter season of 2015-16 at PMAS- Arid Agriculture University Research Farm

Chakwal Road, Koont to evaluate the yield potential of various safflower cultivars grown under organic farming in rainfed conditions and to determine N uptake and crop apparent N recovery of the manures by safflower Plants under the application of PM resulted in highest N uptake of 34 kg/ha as compared to FYM and control which was 31 and 22 kg/ha, respectively. Safflower can be used as an oil seed crop. It is concluded that under organic farming system higher seed, dry matter yield as well as good nutritionally seed can be obtained from safflower. Among the various advance lines TN-79-609 and TN-79-683 are preferred over other lines for good seed as well as dry matter yield.

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