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Nitrogen Requirement of Safflower (*Carthamus tinctorius* L.) for Growth and Yield Traits

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Abstract: The field research was conducted to evaluate the appropriate nitrogen levels for growth, seed yield and relationship of plant characters of safflower at Students Farm, Sindh Agriculture University, Tandojam, Pakistan. Nitrogen levels tested were; 0, 30, 60, 80, 120, 150 and 180 kg ha^{-1}. The experiment was conducted in three-replicated Randomized Complete Block Design. The results revealed that all the crop parameters were affected significantly due to different levels of nitrogen. The performance of safflower (cv. Pawari-95) was significantly promising under nitrogen level of 120 kg ha^{-1} which produced significantly ($p<0.01$) greater branches (7.33), heavy seed index (38.66 g) and better seed yield (-694.66 kg ha^{-1}) whereas, prolonged maturity days (172), tall plants (165.66 cm), more capsules (45.33) were recorded in the plots treated with 180 kg N ha^{-1}. All the crop parameters were also positively associated w ith the seed yield. Thus, 120 kg N ha^{-1} was considered as the optimum level for getting maximum seed yield of safflower, further increase in N levels remained uneconomical by producing adverse effects on all crop parameters. It is recommended that safflower crop may be fertilized at the rate of 120 kg N ha^{-1} where satisfactory seed yield could be achieved.

Key words: Safflower, nitrogen, growth, yield, relationship

INTRODUCTION

Safflower was introduced as oilseed crop in Pakistan in 1960. It is mainly cultivated in Sindh and Baluchistan Provinces. Safflower research work was started in 1976 at National Agricultural Research Centre, Islamabad. Being drought tolerant crop, it is recommended for planting in rainfed areas. In Sindh, it is cultivated on residual moisture after rice. Safflower seed contains 26-37% oil. Its oil is most popular for its high quality (www.Pakissan.com). As a consequence of the disparity between local production and Pakistan's domestic requirements, we import edible oil worth over 3.5 billion rupees. This makes edible oil the second largest import after petroleum products. Consequently, Pakistan should be making efforts to augment local oilseed production. Among oilseed crops, safflower cultivation can help bridge he gap between production and demand, especially as safflower can be grown across the country. At present only 30% edible oil was being produced in the country while the remaining 70% has to be imported. The balance is met through imported oil seeds, which are crushed locally. (Marketing Services Manger, 2002).

The trend of using nitrogenous fertilizer has increased as compared to previous years. Pakistan consumed 843 thousands tones during 1980-81 and Sindh shared 235.5 thousand tones, however, it reached to 2264.5 thousand tones and Sindh province utilized 515.6 thousand tones during 2000-2001 (Anonymous, 2001). Nitrogen management has been the focus of much agricultural research and extension over many years. Soil fertility decline is now widely recognized however, a recent review of nitrogen suggested that research has only provided basic *awareness* information which is not perceived (by farmers) as very helpful in decision making relating to how much fertilizer to apply, or at what time hey pasture rotations should be introduced. Nitrogen (N) fertilizer rates and recommendations have traditionally been based on a series of recipes taking into account the age of the soil and the previous crop. In time, farmers have developed their own rules-of-thumb for N rates and stuck to them, tending to apply the same amount of N following legume or cereal crops. However, producers still perceived a need for package style information which answers specific questions like how do I modify my fertilizer rate given a particular scenario? (Henzell and Daniels, 1995). Very little amount of fertilizer nutrient is added in oilseed crops against a colossal removal of per annum. This is a serious soil health hazard, which needs urgent attention of all concerned. The fertilizer nutrient can play in doubling the oilseeds productivity in the country (Biswas and Soumitradas, 1999). Recent interest

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in safflower has been inspired by several proposed tactical roles that the crop may fulfill in farming systems. Safflower's deep taproot and high water use may be beneficial in drying soil profiles (Beech and Leach, 1989), allowing other crops to be grown in environments prone to waterlogging. Further potential benefits of incorporating safflower into rotations include; production on sodic or saline soils (Van-Hoorn, 1991), improvements to soil structure (Materechera, 1993), a break crop for cereal diseases (Colton, 1988), increased biodiversity, management flexibility and spread of economic risk. These attributes and the fact safflower can be even grown and harvested with conventional machinery, suggest that safflower may offer significant benefits to cropping. Looking the economic importance of the oilseeds, the experiment was conducted to assess the adequate nitrogen requirement for growth and yield parameters of the safflower crop and to observe the relationship of growth parameters with yield of safflower.

MATERIALS AND METHODS

The field experiment was conducted at Student's Farm, Sindh Agriculture University, Tandojam Pakistan. Nitrogen levels tested on safflower variety Pawari-95 were 0, 30, 60, 80, 120, 150 and 180 kg ha^{-1}. The suitable seed bed was prepared through two cross plowings followed by leveling for uniform irrigation application and eradication of weeds. Seeds were planted at the rate of 5 kg ha^{-1}. The plant and row spacing was maintained at 30-35 cm. The 4 irrigations were applied. The first irrigation was applied after one month of sowing, whereas subsequent irrigations at the interval of 15 days were applied upto the physiological maturity of the crop. The rate of N fertilizer applied is integrated in the treatments. The N in the form of Urea was applied in three splits during 1st, 3rd and 4th irrigations, whereas whole P in the form of SSP at the rate of 75 kg ha^{-1} was incorporated during final harrowing. The collected data was statistically analyzed through computer MSTATC statistical package.

RESULTS AND DISCUSSION

The results for plant height, branches, number of capsules, seed index and seed yield showed higher values of safflower (Pawari-95) in the plots where higher levels of nitrogen i.e., 120 to 180 kg N ha^{-1} were incorporated. The minimum values of all plant traits were observed in the plots where no nitrogen was incorporated. It was observed that values of all plants traits linearly increased with an additional increment in nitrogen level and were peak at 120 kg N ha^{-1}, further increase in the nitrogen showed non-significant change in the values of all crop parameters (Table 1). Hence, 120 kg N ha^{-1} was found economically better where maximum seed yield of safflower was recorded.

Table 1: Safflower characters as affected by different nitrogen levels

Nitrogen levels (kg ha^{-1})	Maturity (Days)	Plant height (cm)	Branches per plant	Capsules per plant	Seed index (g)	Seed yield (kg ha^{-1})
0	147.66d	136.66c	2.66d	17.00d	24.00d	589.00e
30	151.00d	140.66b	2.66d	22.33c	27.33c	634.33d
60	156.66c	144.00b	4.33cd	34.00b	29.66bc	652.33c
80	162.66b	153.00ab	5.00bc	37.00b	32.00b	675.00b
120	169.00a	163.33a	7.33a	45.00a	38.66a	694.66a
150	171.00a	164.66a	7.00a	45.33a	37.66a	692.66a
180	172.00a	165.66a	6.66a	45.33a	37.33a	690.66a
Cv(%)	9.86	11.11	10.20	3.26	2.40	9.62
LSD(5%)	4.80	5.84	1.79	3.96	2.68	14.08
LSD(1%)	7.28	8.85	2.72	6.00	4.07	21.33
SE	1.39	1.68	0.52	1.14	0.77	4.07

Table 2: Correlation coefficient values of various crop traits as affected by different nitrogen levels

Character	Maturity (Days)	Plant height (cm)	Branches Per plant	Capsules per plant	Seed index (g)	Seed yield (kg ha^{-1})
Maturity (Days)	1.00					
Plant height (cm)	0.82	1.00				
Branches per plant	0.75	0.87	1.00			
Capsules per plant	0.88	0.89	0.86	1.00		
Seed index (g)	0.87	0.15ns	0.87	0.14ns	1.00	
Seed yield (kg ha^{-1})	0.89	0.67	0.90	0.92	0.96	1.00

The data for crop parameter association with seed yield of safflower indicated that all the crop characters were associated positively with seed yield. Hence it could be predicted that increase in the value of observed plant character significantly affected the seed yield positively (Table 2). Campbell *et al.* (1993) suggested that multiple regression should be applied to relate with grain yield, straw yield, number of grains, seed index and other crop components.

Our soils are deficient in nitrogen for the growth of crops. This deficiency can be overcome by the use of fertilizers, but fertilizer N is not being used efficiently and properly in different crops. It is also the amount of additional grain yield per unit of fertilizer applied. The general concept of balancing supply and demand implies maintaining low levels of mineral N in soil when there is little or no plant growth and providing sufficient N to meet plant requirements during periods of rapid growth (Peoples *et al.*, 1995). The integrated uses of fertilizers not only increase mutual efficiency but also help in the substitution of chemical fertilizers (Ghosh and Sharma, 1999; Anwar and Yousaf, 2000).

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