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# Effect of inclusion of biofertilizers as part of INM on yield and economics of Safflower (*Carthamus tinctorius* L)

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**Abstract:**
The field experiment was conducted during *rabi*(post rainy) season for two years (1999-2000 & 2000-01) on medium deep black soils under receding soil moisture conditions. Results obtained in first year, second year and pooled analysis revealed that all the treatments recorded significantly higher plant height, and yield attributing characters, viz., higher number of branches per plant, number of capitula per plant, number of filled seed per capitula compared to control (no N). Seed inoculation with *Azospirillum* alone resulted in enhanced growth in terms of plant height and other yield attributing characters and was on par with 50% recommended inorganic N application. Seed inoculation with *Azospirillum* both alone and in combination with 50% recommended inorganic N has resulted in on par seed yield with treatment supplied with 50% N and 100% inorganic nitrogen respectively. Interestingly, seed inoculation with *Azotobacter* did not cause any improvement in seed yield. This assumes that seed inoculation with *Azospirillum* could result in absolute saving of 50% of inorganic nitrogen. Increase in seed yield was associated with increment in growth parameter (plant height) and yield attributing characters which was evident from the significant positive correlation between seed yield and growth parameter and seed yield and yield attributing characters.

**Key words**: Biofertilizers - INM, Safflower

## Introduction:

Safflower, *Carthamus tinctorius* L. is a post rainy season rainfed crop known to be associated with healthy oil with high PUFA content. Also, safflower petals are known to have medical properties which help in encountering heart ailments, arthritis etc. The crop is known to be a poor farmer's crop with low input requirements. However, the response of the crop to the applied nutrients is high. Since the chemical fertilizer is the costlier input for crop production, Ram *et.al*, (1992) stressed the need for using biofertilizers technology in compliment with chemical fertilizers. In view of escalating input costs and growing concerns on sustainability and soil health, reliance on Integrated Plant Nutrient Supply (IPNS) systems assuming greater importance in recent days. Biofertilizers are an important component of the IPNS, particularly in dry lands where farmers are tending to rely either on 'no cost' or 'low cost' technologies. It is generally agreed that non-symbiotic and associative symbiotic microorganisms such as *Azotobacter* and *Azospirillum* improve plant growth and yield not only through N Fixation but also through production of phytohormones (Venkateswarulu and Rao, 1983; Okon, 1985; Wani, 1990). The role and importance of biofertilizers in sustainable crop production has been reviewed by several authors (Biswas *et al*., 1985; Wani and Lee, 1992; 1995 a; Katyal *et al*., 1994). Cost effective and renewable alternative resources like biofertilizers pave a safer way towards sustainable agriculture in dry lands. Hence, the present study was under taken to assess the role of non symbiotic Nitrogen fixing microorganisms in safflower production during post rainy season under receding moisture conditions and also to find out the economy in synthetic N fertilization.

## Materials and Methods:

The field experiments were carried out during Rabi seasons of 1999-2000 and 2000-2001 on medium deep black soils under receding soil moisture conditions at Agricultural Research Tandur. The soil was slightly alkaline (PH 8.1), low in available Nitrogen (105 kg/ha), low in available phosphorus (14 kg $P_20_5$) and high in available potassium (990 kg $K_20$/ha). Data on seed yield was recorded in corresponding years and economics and benefit cost ratios were

computed on the basis of the pooled mean for seed yield over the years of experimentation. Mean data of two years for growth parameters and yield attributes was used for interpretation of results.

**Results, Discussions and Conclusions:**

Results obtained in 1999-2000, 2000-2001 and pooled analysis revealed that all the treatments recorded significantly higher plant height, and yield attributing characters, viz., higher number of branches per plant, number of capitula per plant, number of filled seed per capitula compared to control (Table 1 & fig 1). Seed inoculation with *Azospirillum* alone resulted in enhanced growth in terms of plant height and other yield attributing characters and was on par with 50% recommended inorganic N application.

Seed inoculation with *Azospirillum* both alone and in combination with 50% recommended inorganic N has resulted in on par seed yield with treatment supplied with 50% N and 100% inorganic nitrogen respectively. Interestingly, seed inoculation with *Azotobacter* did not cause any improvement in seed yield. This phenomenon is evident from the results obtained from seed inoculation with *Azotobacter* produced on par yields with control. (Table 1). This assumes that seed inoculation with *Azospirillum* could result in absolute saving of 50% of inorganic nitrogen. Similar results were reported by Shesha Saila Sree (2005) in sunflower. Earlier studies by Pragathi Kumari *et. al* (2004) and Khandse *et. al* (1991) in sunflower and safflower respectively indicated the possibility of saving of 25% of inorganic N by seed inoculation with biofertilizers. Increase in seed yield was associated with increment in growth parameter (plant height) and yield attributing characters which was evident from the significant positive correlation between seed yield and growth parameter and seed yield and yield attributing characters (Table-2).

The Economics worked out on the basis of pooled seed yields over two years indicated that the gross returns, net returns and B:C ratio with application of recommended inorganic N in conjunction with seed inoculation with *Azospirillum* were similar and significantly higher than that of use of biofertilizers for seed treatment either alone or in combination, use of 50% N alone and control (Table-1). Similarly the percent improvement in yield was higher in the treatments where ever *Azospirillum* seed inoculation in conjunction with application of 50% recommended N was adopted. This might be due to higher seed yields obtained in the respective treatments. Thus it is clearly indicated that seed inoculation with *Azospirillum* along with 50% recommended N could have reduced the inorganic requirement by 50% to such an extent supplemented by *Azospirillum*. Thus, it can be concluded that the biofertilizers cost is almost pronounced on the seed yield as that of 100% inorganic N, there by 50% saving nitrogen cost without any reduction in seed yield. However, effectiveness of *Azotobacter* as N supplementing agent for rainfed safflower needs further studies.

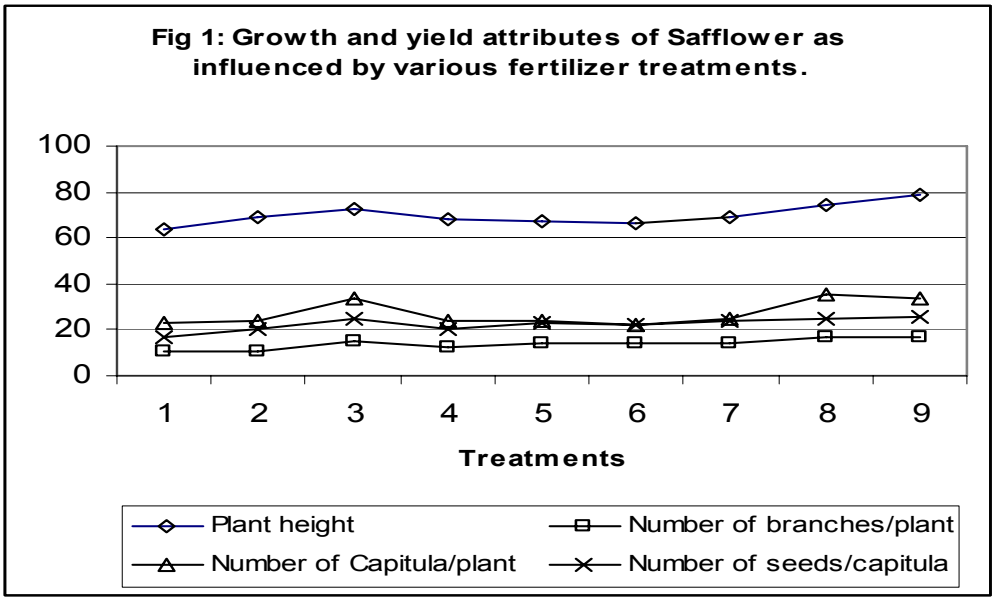
Table 1: Effect of seed inoculation with bio-fertilizers on yield attributes, seed yield and economics of Safflower under rainfed conditions (Pooled mean over two years, 1999-2000, 2000-2001)

| Treatment | Plant height (cm) (Pooled) | No. of branches per plant (Pooled) | No. of Capitula per plant (Pooled) | No. of seeds per Capitula (Pooled) | Seed Yield (Kg/ha.) | | | Gross returns (Rs./ha.) | Net returns (Rs./ha.) | B:C ratio | % Improvement over control |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 1999-00 | 2000-01 | Pooled | | | | |
| Control (No Nitrogen) | 64 | 11 | 23 | 17 | 529 | 551 | 540 | 4863 | 1203 | 1.33 | - |
| 50% N | 69 | 11 | 24 | 20 | 641 | 630 | 635 | 5716 | 1466 | 1.35 | 22.7 |
| 100% N | 73 | 15 | 34 | 25 | 742 | 790 | 766 | 6896 | 2486 | 1.56 | 51.6 |
| *Azotobacter* seed inoculation | 68 | 12 | 24 | 20 | 553 | 597 | 575 | 5176 | 1316 | 1.34 | 3.8 |
| *Azospirillum* seed inoculation | 67 | 14 | 24 | 23 | 623 | 650 | 637 | 5731 | 1871 | 1.48 | 14.1 |
| *Azotobacter* + *Azospirillum* seed inoculation | 66 | 14 | 22 | 22 | 645 | 638 | 642 | 5774 | 1914 | 1.50 | 18.7 |
| 50% N + *Azotobacter* seed inoculation | 69 | 14 | 25 | 24 | 626 | 654 | 640 | 5759 | 1309 | 1.29 | 17.0 |
| 50% N + *Azospirillum* seed inoculation | 74 | 17 | 35 | 25 | 767 | 815 | 790 | 7118 | 2668 | 1.60 | 49.7 |
| 50% N + *Azotobacter* + *Azospirillum* seed inoculation | 79 | 17 | 34 | 26 | 784 | 877 | 829 | 7463 | 3013 | 1.68 | 52.5 |
| SEm ± | 1.047 | 0.642 | 0.962 | 0.703 | 24 | 28 | 20 | - | - | - | - |
| CD (P=0.05) | 3.14 | 1.92 | 2.88 | 2.10 | 73 | 85 | 29 | - | - | - | - |
| CV (%) | 2.6 | 7.9 | 6.1 | 5.4 | 6.4 | 7.1 | 5.2 | - | - | - | - |

Market price for Safflower (Average of 1999-00 and 2000-01): Rs. 900/- per quintal.

Table 2: Correlation and regression values between seed yield vs. yield attributes and growth parameters of Safflower as influenced by various N management practices and seed inoculation with Biofertilizers.

| Character | Correlation values (r) | Regression equation |
|---|---|---|
| Seed yield vs. Yield attributing characters | | |
| Number of branches/plant | 0.903** | Y=122.17+39.636X |
| Number of Capitula/plant | 0.921** | Y=212.43+16.907X |
| Number of filled seeds/Capitula | 0.889** | Y=4.55+29.767X |
| Growth parameter | | |
| Plant height | 0.934** | Y=-271.02+19.942X |




Treatments
1- Control (No Nitrogen); 2- 50% N; 3- 100% N; 4- *Azotobacter* seed inoculation; 5- *Azospirillum* seed inoculation; 6- *Azotobacter* + *Azospirillum* seed inoculation; 7- 50% N + *Azotobacter* seed inoculation; 8- 50% N + *Azospirillum* seed inoculation; 9- 50% N + *Azotobacter* + *Azospirillum* seed inoculation

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