**Economics of hybrid mustard crop (Brassica Juncea L.) cultivation following foliar application of micronutrients and sulphur at various stages of growth**

**ABSTRACT**

An experiment was carried out for consecutive 2 years during the *Rabi* season of 2022-23 and 2023-24 at the Crop Research Farm of the University. The soil was sandy loam in texture, low in organic carbon, potassium and medium in available nitrogen, phosphorus. The experiment consists of 16 treatments with three replications in Randomized Block Design). Foliar application of micronutrients and sulphur in various concentrations was done at 45 and 65 DAS with the objective to ascertain impact of these nutrients on overall economics of mustard (Pioneer hybrid 45S46) cultivation in sandy loam soil of Prayagraj, U.P. Economics of crop was calculated on the basis of inputs incurred during 202-23 and 2024 for agricultural operations, followed by gross return, net return and Benefit: Cost ratio (B: C).

 Experimentation for 2 years concluded that [gross return (Rs ha-1), net return (Rs ha-1) and benefit-cost ratio] of different treatments were worked out on the basis of input output analysis. The data on gross return in different treatment varied significantly. The highest gross return was obtained in the treatment T11 (RDF + Sulphur @ 1.0%) during both years and pooled data (124112, 136255 and 130183Rs. ha-1, respectively) which was significantly higher than RDF. The data on net return revealed the highest net return (91937, 100180 and 96058 Rs. ha-1, respectively) was also obtained from the treatmentT11: RDF + Sulphur @ 1.0% during both the years and pooled data. The benefit-cost ratio was significant among treatments. Maximum benefit-cost ratio was noted in treatment T11: Sulphur @ 1.0% (2.86, 2.78 and 2.82) during both the years and pooled data which was significantly more than RDF.

Key words: Mustard, Hybrid, Economics, Micronutrients, Sulphur.

**Introduction:**

Vegetable oil has one of the highest shares (40%) of the production of all agricultural commodities globally. Among the seven edible oil seed cultivated in India, Rapeseed mustard is the second-most important oilseed crop in India, next only to soybean, with almost one-fourth share in both area and production (Jat et al., 2019). It was grown on 6.86 million ha in India, with a production of 9.12 million tons and a productivity of about 1329 kg/ha (Ministry of Agriculture, 2021). Adoption of improved varieties and their timely sowing are important factors for improving their productivity. Different cultivars may respond differently to different sowing time (Rajput et al. 1991, Sharma and Kumar, 2023). Mustard is the most responsive crop to weather and has different results at different sowing times. Sowing at times plays a prime role in providing growing conditions i.e. temperature, humidity, rain, and light intensity. The development period of mustard should synchronize with ideal conditions for better articulation of growth and yield. Rapeseed and mustard are usually sown by the end of September to the second fortnight of October in north India when grown as a sole crop or on dates of the main crop when sown as mixed or intercrop. But, with the development of new varieties of crops and the adoption of multiple cropping systems under irrigated conditions, it has become essential to extend their sowing from October to mid- November or even later. In the present study, we have reported application of various combinations of micronutrients and sulphur at two growth stages of hybrid mustard crop, as reported; sulphur fertilization enhances mustard seed quality resulting in test weight. Studies suggest that sulphur applications can improve mustard seed test weight by enhancing nutrient availability and protein content (Patel et al., 2014). This work has been designed to evaluate different combinations of foliar spray of micronutrients and sulphur in hybrid mustard crop in sandy loam soil of Prayagraj. The study has resulted in valuable insights for improving mustard productivity and impacting crop's economic viability.

**Materials and methods:**

The study was conducted at Crop Research Farm, Samhigginbottom University of Agriculture, Technology and Science, Prayagraj, Uttar Pradesh during rabi season, 2022-23 and 2023-24. The soil was sandy loam in texture, low in organic carbon and medium in available nitrogen, phosphorus and low in potassium. Hybrid variety; Pioneer hybrid 45S46 was sown with spacing of 45 cm × 20 cm. The experiment was laid down in Randomized Block Design with 16 treatments (RDF 80:40:40 (kg N:P2O5:K2O/ha,T1: RDF + ZnSO4.7H2O @ 0.25% ,T2: RDF + ZnSO4.7H2O @ 0.5% T3: RDF + molybdenum @ 0.05%,T4: RDF + molybdenum @ 0.1%, T5: RDF + Boron @ 0.05%,T6: RDF + Boron @ 0.1%,T7: RDF + FeSO4.5 H2O @ 0.2%,T8: RDF + FeSO4.5 H2O @ 0.4%,T9: RDF + 2% Sulphur @ 0.5%,T10: RDF + 2% Sulphur @ 1.0%:T11: RDF + MnSO4 @ 0.2%, T12: RDF + MnSO4 @ 0.4%, T13: RDF + CuSO4.5 H2O @ 0.2%, T14: RDF + CuSO4.5 H2O @ 0.4%, T15: Control,T16) replicated thrice. The data generated following 2 years of experimentation was analyzed using ANOVA for interpretation.

**Results and discussion:**

Results obtained following 2 years of experimentation are presented in tables-1 and-2.

**Gross return, Net return and B:C ratio:**

The data on gross return in different treatment varied significantly. The highest gross return was obtained in the treatment T11 (RDF + Sulphur @ 1.0%) during both years and pooled data (Rs.124112,136255 and 130183 ha-1, respectively) which was significantly higher than RDF. Significant differences were observed for net return. The data on net return revealed that the highest net return (Rs.91937, 100180 and 96058 ha-1,respectively) was obtained from the treatmentT11: RDF + Sulphur @ 1.0% during both the years and pooled data. This treatment was significantly superior to RDF. The benefit-cost ratio was significant among treatments. Maximum benefit-cost ratio was noted in treatment T11: Sulphur @ 1.0% (2.86, 2.78 and 2.82) during both the years and pooled data which was significantly higher than RDF. Kumar and Tiwari (2024) recorded Rs 1,16,993.30-1,23,533.30/ha gross return; Rs.1,16,811.70-1,23,170.00/ha and Rs.1.01,006.70-1,24,623.30/ha, respectively; net return, Rs. 66,374.50-72,914.50,66,192.90-72,551.20,50,387.90-74,004.50/ha, respectively and B:C ratio of 1.32-1.45, 1.33-1.44 and 1.01-1.35, respectively in RH-404,DRMR and NRCM varieties, respectively. Yadav and Debberma (2024) reported maximum gross return (1,10,546.40 INR/ha), net return (75,546.40 INR/ha) and B:C ratio (2.16) in treatment 8 of their experiment when applied 30 kg sulphur/ha+20 kg/ha Zinc. Patil et al.(2024) also noted Rs.1,30,905, Rs.81,592 and 1.97, gross return, net return and B:C ratio, respectively in mustard hybrid (M-400) which are at par with our findings. Further, Priyanka et al.(2024) have also found similar economic return following integrated nutrient management on yield and economic returns in mustard(Brassica juncea L). They also revealed Rs.1,05,798; 1,16,624 gross return; Rs.71,988; 82,814 net return/ha and 2.13, 2.44 B:C ratio in 2022 and 2023, respectively which are again in align with our findings. Ram Bharose et al.(2025) also reported Rs. 1,01,972 gross return and Rs. 65,277/ha net return with B:C ratio of 1.77 following use of RDF with boron in mustard crop which are close to our findings. Kumar et al.(2025) have studied the cost of cultivation, net return and B:C ratio of mustard cultivation in various size of the farm and found that per hectare input cost was Rs 42,135.45 on marginal farms,Rs.44164.74 in small farms and Rs.51,411.71 on large farms. The net return were highest i.e. Rs 89,610.89 followed by small farms and marginal farms i.e. Rs 75,747.40 and Rs.71,546.55, respectively with B:C ratio of 2.7. However, Deewan et al.(2024) reported lesser gross return(Rs.46,763/ha), net return(Rs.39,663/ha but higher B:C ration(5.59) under semi-arid condition of Rajasthan in timely sown Pusa Jai kisan variety of mustard.

**Table-1: Effect of Foliar spray of micronutrients and sulphur on cost of cultivation and gross return of mustard.**

|  |  |  |
| --- | --- | --- |
| **Sr. No.** | **Treatments** | **Economics** |
| **Cost of cultivation (Rs. ha-1)** | **Gross return (Rs. ha-1)** |
| **2022** | **2023** | **Pooled** | **2022** | **2023** | **Pooled** |
| 1 | RDF (80:40:40) | 30375 | 34075 | 32225 | 103772 | 112257 | 108014 |
| 2 | RDF + ZnSO4@ 0.25%  | 31931 | 35831 | 33881 | 115637 | 126338 | 120988 |
| 3 | RDF + ZnSO4@ 0.5%  | 32285 | 36185 | 34235 | 122228 | 135858 | 129043 |
| 4 | RDF + Molybdenum @ 0.05% | 33075 | 36975 | 35025 | 115072 | 125942 | 120507 |
| 5 | RDF + Molybdenum @ 0.10% | 34575 | 38475 | 36525 | 116578 | 128123 | 122351 |
| 6 | RDF + Boron @ 0.05% | 31855 | 35755 | 33805 | 120722 | 134470 | 127596 |
| 7 | RDF + Boron @ 0.1% | 32135 | 36035 | 34085 | 122982 | 136652 | 129817 |
| 8 | RDF + FeSO4 @ 0.2%  | 33687 | 37587 | 35637 | 115825 | 124355 | 120090 |
| 9 | RDF + FeSO4@ 0.4%  | 35799 | 39699 | 37749 | 120722 | 134668 | 127695 |
| 10 | RDF + Sulphur @ 0.5% | 31875 | 35775 | 33825 | 116202 | 125347 | 120774 |
| 11 | RDF + Sulphur @ 1.0% | 32175 | 36075 | 34125 | 124112 | 136255 | 130183 |
| 12 | RDF + MnSO4 @ 0.2%  | 34575 | 38475 | 36525 | 113000 | 122967 | 117983 |
| 13 | RDF + MnSO4 @ 0.4%  | 37575 | 41475 | 39525 | 114130 | 124553 | 119342 |
| 14 | RDF + CuSO4 @ 0.2%  | 36375 | 40275 | 38325 | 119403 | 135065 | 127234 |
| 15 | RDF + CuSO4 @ 0.4%  | 41175 | 45075 | 43125 | 121287 | 136057 | 128672 |
| 16 | Control  | 25435 | 28935 | 27185 | 54617 | 62277 | 58447 |
|  | **F-test** |  |  |  | S | S |  |
|  | **SEm (±)** |  |  |  | 4949 | 7531 |  |
|  | **CD (p=0.05)** |  |  |  | 14363 | 21857 |  |

**Table-2: Effect of Foliar spray of micronutrients and sulphur on net return and benefit cost ratio of mustard.**

|  |  |  |
| --- | --- | --- |
| **Sr. No** | **Treatments** | **Economics** |
| **Net return (Rs. ha-1)** | **B:C** |
| **2022** | **2023** | **Pooled** | **2022** | **2023** | **Pooled** |
| 1 | RDF (80:40:40) | 73397 | 78182 | 75789 | 2.42 | 2.29 | 2.36 |
| 2 | RDF + ZnSO4@ 0.25%  | 83706 | 90507 | 87107 | 2.62 | 2.53 | 2.57 |
| 3 | RDF + ZnSO4@ 0.5%  | 89943 | 99673 | 94808 | 2.79 | 2.75 | 2.77 |
| 4 | RDF + Molybdenum @ 0.05% | 81997 | 88967 | 85482 | 2.48 | 2.41 | 2.44 |
| 5 | RDF + Molybdenum @ 0.10% | 82003 | 89648 | 85826 | 2.37 | 2.33 | 2.35 |
| 6 | RDF + Boron @ 0.05% | 88867 | 98715 | 93791 | 2.79 | 2.76 | 2.78 |
| 7 | RDF + Boron @ 0.1% | 90847 | 100617 | 95732 | 2.83 | 2.79 | 2.81 |
| 8 | RDF + FeSO4 @ 0.2%  | 82138 | 86768 | 84453 | 2.44 | 2.31 | 2.37 |
| 9 | RDF + FeSO4@ 0.4%  | 84923 | 94969 | 89946 | 2.37 | 2.39 | 2.38 |
| 10 | RDF + Sulphur @ 0.5% | 84327 | 89572 | 86949 | 2.65 | 2.50 | 2.57 |
| 11 | RDF + Sulphur @ 1.0% | 91937 | 100180 | 96058 | 2.86 | 2.78 | 2.82 |
| 12 | RDF + MnSO4 @ 0.2%  | 78425 | 84492 | 81458 | 2.27 | 2.20 | 2.23 |
| 13 | RDF + MnSO4 @ 0.4%  | 76555 | 83078 | 79817 | 2.04 | 2.00 | 2.02 |
| 14 | RDF + CuSO4 @ 0.2%  | 83028 | 94790 | 88909 | 2.28 | 2.35 | 2.32 |
| 15 | RDF + CuSO4 @ 0.4%  | 80112 | 90982 | 85547 | 1.95 | 2.02 | 1.98 |
| 16 | Control  | 29182 | 33342 | 31262 | 1.15 | 1.15 | 1.15 |
|  | **F-test** | S | S | S | S | S | S |
|  | **SEm (±)** | 4949 | 7531 |  | 0.15 | 0.20 |  |
|  | **CD (p=0.05)** | 14363 | 21857 |  | 0.44 | 0.59 |  |

**Conclusion:**

Application of RDF + Sulphur @ 1% recorded significantly higher gross return (1,24,112, 1,36,255 and 1,30,183 Rs. ha-1, respectively), net return (91,937, 1,00,180 and 96,058 Rs. ha-1, respectively) and B:C ratio (2.86, 2.78 and 2.82, respectively) than RDF during both the years and in pooled data. Thus, it is more profitable to the farmers under field conditions.

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