# Effect of Bone Meal and Intercropping on Productivity and Quality of Sesame (*Sesamum indicum* L.)

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***Abstract***— *A field experiment was conducted in Kharif season of 2024–2025 at the Agricultural Research Farm, Department of Agronomy, Himalayan University, Jollang, Itanagar, Arunachal Pradesh. The soil of experimental plot was sandy loam and loamy sandy in texture with pH ranges from 4 to 6. The experiment was laid out in a Randomized Block Design (RBD) with seven treatments each replicated thrice three. The treatments which are T1: Control, $T_2$:Bone meal at 70 kg/ha.+ intercropping (2:1), $T_3$: Bone meal at 70 kg/ha. +intercropping (2:2), $T_4$: Bone meal at 70 kg/ha.+ Intercropping (2:1), $T_5$: Bone meal at 70 kg/ha. + intercropping (2:2), $T_6$: Bone meal at 70 kg/ha.+ intercropping (2:1), $T_7$: Bone meal at 70 kg/ha.+ Intercropping (2:2). The results showed maximum productivity of were recorded significantly higher in the treatment $T_7$ which is Bone meal at 70 kg/ha.+Intercropping (2:2), number of capsule/plant (.33.67), capsule length (3.5cm) , seeds/capsule (78), test weight (3.2g), economic yield (0.3 t/ha), biological yield (2 t/ha), but in harvest index T1: Control has shown maximum result i.e., (19.19) and maximum quality of oil content in sesame (6.35%) and in protein content (35.06%) were recorded in the treatment $T_7$ as compared to all the other treatments.*

***Keywords*— *Bone meal, Intercropping, Sesame, Yield and quality.***

## I. INTRODUCTION

Sesame (*Sesamum indicum* L.) is one of the oldest and most important oilseed crops, cultivated extensively in tropical and subtropical regions across more than 70 countries. It is highly valued for its adaptability to adverse climatic conditions, particularly drought and high temperatures, due to its deep root system and low water requirement. India ranks among the leading producers of sesame, with cultivation spread over 1.77 million hectares and a productivity of 456 kg/ha (Anonymous, 2016; Singh *et al., (*2017). Sesame seeds are rich in oil (46–52%), proteins, antioxidants, and essential minerals such as calcium, magnesium, and iron. These properties make sesame a functional food with applications in the culinary, cosmetic, and pharmaceutical industries. However, despite its resilience and economic value, sesame yields remain low, primarily due to poor soil fertility, limited input use, and traditional agronomic practices.

Among organic nutrient sources, bone meal has shown considerable potential in improving soil fertility and crop productivity. It is a slow-release organic fertilizer rich in phosphorus and calcium, essential for root development, photosynthesis, and cell wall strengthening. Application of bone meal improves phosphorus availability in the rhizosphere, particularly in acidic or phosphorus-deficient soils, thereby enhancing early plant vigor and yield components. Its use not only supports sustainable nutrient management but also aligns with organic farming practices aimed at reducing chemical fertilizer dependence (Tesfaye *et al., (*2021) Sharma *et al.,* (2013), Hussain *et al., (*2020).

In addition to organic nutrient supplementation, intercropping is a promising agroecological practice that improves land use efficiency, resource utilization, and overall system productivity. When sesame is intercropped with compatible species, particularly legumes, it benefits from enhanced soil nitrogen through biological fixation, reduced weed competition, and minimized pest and disease pressure. Intercropping also contributes to soil conservation and income diversification, making it especially beneficial for smallholder farmers aiming to improve productivity without expanding cultivated land (Agegnehu *et al., (*2017), Lithourgidis *et al., (*2011).

## II. MATERIALS AND METHODS

The experimental trial was conducted during the Kharif season of 2024 at the Agricultural Research Farm of Himalayan University, located at 27.14° N latitude and 93.62° E longitude. The site, situated in Jollang, falls under a tropical climatic zone, receiving an average annual rainfall of 3500–4000 mm and lying at a moderate elevation above mean sea level. The soil of the experimental field was predominantly sandy loam to loamy sand in texture, with a pH ranging from 4.0 to 6.0.

The experiment followed the recommended dose of fertilizers (NPK: 20:20:30), and bone meal was applied according to the treatment specifications. Sowing was followed by gap filling to ensure uniform plant population, and although irrigation was provided, it was not applied regularly due to frequent natural rainfall.

Observations on productivity after the harvest the yields parameters such as number of capsules per plant, seeds per capsule, test weight (1000-seed weight), seed yield (t/ha), biological yield (t/ha), and harvest index (%) and quality of oil and protein content (%) in sesame were recorded. Data collected were statistically analyzed using Analysis of Variance (ANOVA) appropriate for a Randomized Block Design (RBD).

## III. RESULTS AND DISCUSSION

### 3.1 The statistical data regarding quality parameters is presented in Table no:1:

#### 3.1.1 Oil content in sesame (%):

The significant and highest oil content (6.35 %) was recorded in treatment $T_7$ Bone meal at 80kg/ha + intercropping at 2:2 and closely followed by $T_6$ Bone meal at 80kg/ha + intercropping at 2:1 i.e., 5.98 %. The lowest oil content was recorded in T1 i.e., 3.62 %.The increase under T7 may be due to improved phosphorus availability enhancing lipid biosynthesis, along with better nutrient synergy from intercropping systems (Ali *et al.*, 2015; Patel *et al.*, 2020). Similar findings by Rani and Babu (2018) also suggest that integrated nutrient and cropping systems positively influence sesame oil content.

#### 3.1.2 Protein content in sesame (%):

The significant and highest protein content (35.06 %) was recorded in treatment $T_7$ Bone meal at 80kg/ha + intercropping at 2:2 and closely followed by $T_6$ Bone meal at 70kg/ha + intercropping at 2:2 i.e., 32.98%. The lowest protein content was recorded in $T_5$ Bone meal at 75kg/ha + intercropping at 2:2 i.e., 27.14 %. Which enhanced protein levels under $T_7$ may be attributed to better phosphorus availability, which is essential for nitrogen metabolism and protein synthesis (Ali & Mahmoud, (2014). The use of bone meal also improves soil microbial activity, indirectly boosting protein accumulation (Nweke *et al., (*2018), Ghosh *et al., (*2020).

### 3.2 The statistical data representing yield and yield attributes presented in Table no. 2:

#### 3.2.1 No. of capsule plant$^{-1}$:

The number of capsules per plant at 60 and 90 DAS showed significant variation among treatments. The highest number was recorded in T7 (Bone meal at 80 kg/ha + intercropping 2:2) with 21.00 and 33.67 capsules, respectively, while the lowest was in control (T1) with 5.66 and 8.33 capsules. The improvement in T7 may be attributed to enhanced phosphorus availability from bone meal and better nutrient utilization through intercropping, which supports reproductive growth (Adeyemo *et al., (*2019), Singh *et al., (*2021), Ogunyemi *et al., (*2018).

#### 3.2.2 No. of seed capsule$^{-1}$:

The number of seeds per capsule at 90 DAS (Table 4.10) was significantly influenced by treatments, with the highest count in T7 (Bone meal at 80 kg/ha + intercropping 2:2) at 78 seeds per capsule, while the lowest was in T1 (Control) with 55 seeds. The increased seed number in T7 may be due to improved nutrient availability, especially phosphorus from bone meal, which enhances reproductive development, and intercropping, which promotes efficient nutrient use and better pollination (Ghosh *et al., (*2020), Adeyemo *et al., (*2019), Rani & Babu, (2018).

### 3.2.3 Capsule Length (cm):

Capsule length at 60 and 90 DAS was significantly highest in T7 (Bone meal at 80 kg/ha + intercropping 2:2), recording 2.2 cm and 3.5 cm respectively, while the lowest was in control (T1) with 1.2 cm and 2.3 cm. The improvement in T7 may be due to better phosphorus availability from bone meal and enhanced nutrient uptake through intercropping (Adeyemo *et al., (*2019) Sharma *et al., (*2020) Ogunyemi *et al., (*2018).

### 3.2.4 Test weight (g):

Test weight of 1000 seeds at harvest was significantly influenced by treatments, with the highest value in T7 (Bone meal at 80 kg/ha + intercropping 2:2) at 3.2 g and the lowest in T1 (Control) at 2.50 g. The increase in test weight under T7 may be due to improved nutrient availability and assimilation during seed filling, enhanced by phosphorus from bone meal and better crop synergy through intercropping (Sharma *et al., (*2020), Singh *et al., (*2021), Adeyemo *et al., (*2019).

### 3.2.5 Economic yield (t/ha$^{-1}$):

Economic yield (t ha$^{-1}$) at harvest was significantly influenced by treatments, with T7 (Bone meal at 80 kg/ha + intercropping 2:2) recording the highest yield of 0.30 t ha$^{-1}$, while the lowest was in T1 (Control) at 0.17 t ha$^{-1}$. The increased yield in T7 could be due to improved nutrient availability from bone meal and enhanced growth and resource use efficiency under intercropping, which together promote better seed development and harvest output (Adeyemo *et al., (*2019), Sharma *et al., (*2020), Ogunyemi *et al., (*2018).

### 3.2.6 Biological yield (t/ha):

Biological yield (t ha$^{-1}$) at harvest was significantly affected by the treatments, with the highest yield in T7 (Bone meal at 80 kg/ha + intercropping 2:2) at 2.00 t ha$^{-1}$, and the lowest in T1 (Control) at 0.90 t ha$^{-1}$. The increase in T7 can be linked to better plant growth and biomass accumulation due to the combined effect of slow-release phosphorus from bone meal and improved resource utilization in the intercropping system (Singh *et al., (*2021), Adeyemo *et al. (*, 2019), Ogunyemi *et al., (*2018).

### 3.2.7 Harvest index (%):

Harvest index (%) at harvest was significantly influenced by treatments, with the highest value in T6 (Bone meal at 80 kg/ha + intercropping 2:1) at 21.5%, and the lowest in T7 (Bone meal at 80 kg/ha + intercropping 2:2) at 15.14%. The higher harvest index in T6 suggests better partitioning of assimilates towards economic yield, while the lower value in T7 may be due to greater vegetative biomass reducing the proportion of economic yield (Sharma *et al., (*2020), Singh *et al., (*2021), Adeyemo *et al.,* 2019).

**TABLE 1**
**EFFECT OF BONE MEAL AND INTER CROPPING ON QUALITY OF SESAME**

| Treatments No. | Oil (%) | Protein (%) |
|---|---|---|
| T1 | 3.62 | 27.72 |
| $T_2$ | 4.17 | 32.98 |
| $T_3$ | 4.31 | 28.02 |
| $T_4$ | 4.96 | 30.5 |
| $T_5$ | 5.38 | 27.14 |
| $T_6$ | 5.98 | 32 |
| $T_7$ | 6.35 | 35.07 |
| SEd | 0.31 | 0.64 |
| SEm(±) | 0.22 | 0.45 |
| CD | 0.61 | 1.25 |

**TABLE 2**
**EFFECT OF BONE MEAL AND INTERCROPPING ON PRODUCTIVITY OF SESAME**

| Treatments | No. of capsule plant$^{-1}$ | No. of seed capsule$^{-1}$ | Capsule length(cm) | Test weight(g) | Seed/Economic yield(t/ha) | Biological yield(t/ha) | Harvest index(%) |
|---|---|---|---|---|---|---|---|
| T1 | 8.33 | 55 | 2.3 | 2.5 | 0.17 | 0.9 | 19.17 |
| $T_2$ | 14.33 | 64 | 3 | 2.6 | 0.2 | 1.16 | 17.21 |
| $T_3$ | 17.33 | 67 | 2.8 | 2.57 | 0.21 | 1.06 | 19.42 |
| $T_4$ | 21.33 | 71 | 3.13 | 2.7 | 0.24 | 1.36 | 17.4 |
| $T_5$ | 25.33 | 74 | 3.07 | 2.8 | 0.26 | 1.28 | 20.07 |
| $T_6$ | 29.33 | 76 | 3.37 | 3 | 0.29 | 1.72 | 16.63 |
| $T_7$ | 33.67 | 78 | 3.5 | 3.2 | 0.3 | 2 | 15.14 |
| SEd | 0.62 | 2 | 0.29 | 0.06 | 0.01 | 0.05 | 1.2 |
| S.Em (±) | 0.44 | 1.41 | 0.21 | 0.04 | 0.01 | 0.04 | 0.85 |
| CD | 1.21 | 3.92 | 0.57 | 0.12 | 0.02 | 0.1 | 2.36 |

## IV. CONCLUSION

Based on the findings of the investigation it may be concluded that $T_7$ (Bone meal at 80 kg/ha + intercropping 2:2) performed exceptionally in all growth and yield parameters and in obtaining maximum seed yield of sesame. Hence, (Bone meal at 80 kg/ha + intercropping 2:2) is beneficial for future use.


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