

APPLICATION OF BIOTECHNOLOGY AGRICULTURAL BY MANURE, EFFORT OF SESAME PRODUCTION IN COASTAL SANDY LAND

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Abstract

Coastal sandy land as one of marginal land which potential become to be a sustainable productive land. Annual crops such as Sesame cultivation proper to developed as an agribusiness crops in coastal sandy land. Integrated fertilizer model (by manure, or organic fertilizer and inorganic fertilizer)Manure fertilizer, is one of Biotechnology in agricultures products. This study aimed to know the growth and yield of Sesame (*Sesamum indicum* L.) in quantity and quality through the combination treatment of manure and inorganic proportionately which refers to the dose and type of manure elected. Phase II study conducted in a polybag, for planting. This study conducted in Banguntapan Yogyakarta, Agricultural station lab. from September - December 2012 aimed to determine the proportion of fertilizer best combination of sesame results based on the dose of manure was selected from the results of the Phase I study (chicken manure 30 t / ha).

This study used a factorial experiment (7 X 2) were prepared by completely randomized design (CRD) with repetition three times. Experiment arranged in factorial with two-factor, repeated three times. First factor is combination of manure and inorganic fertilizer (K), there are 7 types: (Sandy Land media: K₀ 1. Chicken manure 30 t / ha: K₁, 2. Chicken manure 15 tonnes / ha (100% recommendation farmers) + inorganic fertilizers (N, P, K deficiency is equivalent to substitute 15 tonnes / ha of chicken manure): K₂, 3. chicken manure 11.25 tonnes / ha (75% of farmers recommendation) + inorganic fertilizers (N, P, K deficiency replacement dose equivalent to 18.75 tonnes / ha of cow manure): K₃ 4. chicken manure 7.5 t / ha (50% of farmers recommendation) + inorganic fertilizers (N, P, K deficiency replacement dose equivalent to 22.5 tonnes / ha of chicken manure): K₄ ,5. chicken manure 3.75 t / ha (25% of farmers recommendation) + inorganic fertilizers (N, P, K deficiency replacement dose equivalent to 26.25 tonnes / ha of chicken manure): K₅ ,6. inorganic fertilizers (N, P, K deficiency replacement dose is equivalent to 30 tons / ha of chicken manure): K₆. Second factor is the variety: Sumberrejo-1, Sumberrejo-2, Variable observed were: plant height, days to flowering, day of harvest, seed weight per plant, weight of 1000 seeds, and seed oil content. The data analyzed by Anova 5%, with further testing Duncan 5%. The results showed The fastest flowering (45 days) was on the control treatment. The age of harvest is almost the same, 105 days. Highest total seed oil content, 42.72%, obtained in the treatment of chicken manure 7.5 t / ha (50% of farmers recommendation) + inorganic fertilizers (N, P, K deficiency replacement dose equivalent to 22.5 tonnes / ha of chicken manure) in Sumberrejo-1

Keywords: Coastal sandy land, organic fertilizer, inorganic, Sumberrejo-1, Sumberrejo-2 Sesame (*Sesamum indicum* L.)

1. Introduction

Coastal sandy land, which is not classified as fertile land for plant growth and development, so it has low productivity. Productivity low coastal sandy soil caused by limiting factors such as the ability to hold and store the low water, infiltration and evaporation is high, the level of fertility and organic matter, as well as low water use efficiency. The presence of coastal sandy land is one of the natural resources that have not been used optimally. Not serious land use is one of them caused by the many requirements needed to be devel-

oped into productive agricultural land (Gunadi et al., 2007). sandy land contains 0.25% organic matter which is low, pH 6.15 (acid), 0.17% of N total classified as very low, containing 254 mg / 100g P and 0.05 cmol (+) / kg K is available, 99% sand texture (classified as very porous), loose consistency so buffering capacity of water and fertilizer is very low, 1% clay, 0.90 cmol (+) / kg for the value of the Commission, (Parwata, 2010). The wind speed is relatively high salt, can reach 50 km / h. Daily soil surface temperatures can reach the beach sand land range 26.9 - 31,5° C (Sarjijah,

1997). Utilization and sand land development stems from the reduction of productive agricultural land is always available, either for residential, industrial as well as for other purposes. Through the simple application of agricultural biotechnology through the use of organic fertilizer (manure) to change the land near optimal conditions for plant growth (Nurhayati *et al.*, 2010).

The role of organic matter most to the physical properties of soil including structure, consistency, porosity, water binding, and increased resistance to erosion (Suntoro, 2003). In the land of sand, the addition of organic matter is expected to change the structure of the soil from becoming single grained aggregates, thereby increasing the degree of structure and aggregate size or increase the class structure of fine to medium or coarse (Scholes *et al.*, 1994). The influence of organic matter on the ground beside the increase in porosity associated with soil aeration, also deals with the status of the water content in the soil. The addition of organic matter will improve the ability to hold water so that the soil's ability to provide water for plant growth increases. The addition of organic matter in the sandy soil will affect the capacity of the field, so that the water holding capacity increases, and the impact on increasing the availability of water for plant growth (Salwa, 2011).

The role of organic matter on the availability of nutrients in the soil can not be separated with the mineralization process is the final stage of the reform process of organic materials. In the process of mineralization will be released with a complete plant nutrient (N, P, K, Ca, Mg and S, and micronutrients) in relatively small quantities. N, P and S are relatively more nutrients to be released and can be used crop. The role of macro nutrients (N and P), as the basic constituent of proteins, polysaccharides, fats, and plays a role in the transport of energy, stimulating root growth, helping assimilation and respiration, accelerate flowering and ripening seeds or fruit and produce energy and nutrient K plays a role in sugar translocation in the phloem, and osmotic adjustment, strengthen the stems to the leaves, flowers and fruits are not easy to fall, increasing the resistance of plants resist drought and disease, while the micro nutrients (Fe, S, Cl, Zn and Mo), as an electron transporter and enzyme activator (Rasheed *et al.*, 2004).

N fertilization at doses of 100-200 kg / ha affect the amount of interest earned, and the number of seeds and oil content in sesame grown in

sand soil (El-Nakhlawy and Shaheen, 2009). In Shehu *et al.*, (2010), submitted that the sesame plant, does not require too much fertilizer, unless planted in soil that is very nutrient. Plants need nutrients to perform metabolic processes, especially during the vegetative. It is expected that absorbed elements can be used to encourage cell division and the formation of new cells to form plant organs such as leaves, stems, and roots were better so as to expedite the process of photosynthesis.

Syukur(2005), the provision of 20 tons / ha of cow manure that is able to improve soil quality and increase the water-binding ability of N availability that promote growth / caisim results. The addition of organic matter to reduce dependence inorganic fertilizer naturally in efforts to achieve environmentally friendly farming. It was clarified by the results of the study of El-Habasha *et al.* (2007) which states that the use of organic materials in the cultivation of sesame plants naturally protect the environment from pollution. Cattle manure application can increase the number of pods at 17.5%. Due to the presence of macro and micro elements contained in the organic fertilizer can increase plant height and number of books (nodes) thus increasing the amount capsule . Balance fertilization by providing manure 20 tonnes / ha and inorganic N fertilizer level of 150 kg / ha on the variety and Yekta by Mujaya Yerokan (2003), gave the highest oil yield, 1.5 tons / ha along with high seed production 2.7 tons / ha.

The use of organic materials is an effective and eco friendly approach. In fact, sometimes the farmers shortage of organic fertilizer from livestock kiotoran jumlah process results obtained, for the models in this study applied an organic fertilizer instead of proportionately.

Sesame is an agricultural commodity The Queen of Oil Seeds crops, which reflects that the sesame seeds have a high nutrient content and a positive impact on consumers (Hand, 2006). Hwang (2005) convey, proximate composition of sesame seeds varied in terms of varieties, seed color and seed coat surface properties. Oil content is influenced by plant growth conditions, and daily temperatures. Presented also by Khalid (2008), the composition of the oil quality is influenced by climatic conditions, soil types, varieties and harvesting, in addition to the action proper fertilization can increase the yield of sesame. Nath, *et al* (2003) expressed, that the resistance of sesame plant growth is affected by low temperatures (<27°C) and a low rate of photosynthesis. Research that has been carried out by Nurhayati,

et al (2012), chicken manure 30 to / ha gave significantly different results from the treatment of cattle and sheep manure on levels of sesame oil on the variety Sumberejo 1.

2. Materials and Methods

The pot experiments were conducted in Banguntapan, the experimental field of the Agronomy sciences Agricultural University of Gadjah Mada, Yogyakarta - Indonesia. Using the proportion of fertilizer best combination of sesame results based on the dose of manure was selected from the first results (chicken manure 30 tonnes / ha). This study used a factorial experiment (7 X 2) were prepared by completely randomized design (CRD) with 3 repetitions. There are two factors research include: combination of chicken manure and inorganic fertilizer (K), Factor I: types of sesame (V) by 2 varieties), V₁ = white sesame, V₂ = black sesame

Note :Treatment of an organic fertilizer NPK fertilizers: The source of NPK derived from N: in the form of Urea 46%, P: SP 36 and K in the form of KCl,NPK on K₂ treatments: 1.2 g urea; 1.05 g SP 36; 0.66 g of KCl, NPK on K₃ treatments: 1.45 g of urea; 1.25 g SP 36; 0.70 g of KCl, NPK in the treatment of K₄: 1.85 g of urea; 1.60 g SP 36; 0.99 g of KCl, NPK on K₅ treatment: 2.10 g of urea; 1.80 g SP 36; 1.15 g of KCl, NPK in treatment K₆: 2.40 g of urea; 2.10 g SP 36; 1.22 g of KCl

Factor II (K) : a combination of organic and inorganic fertilizers, consisting of seven levels
 1. Sandy land media : K₀,2. chicken manure 30 tonnes / ha: K₁,3. Chicken Manure 15 tonnes / ha (100% recommendation farmers) + inorganic fertilizers (N, P, K deficiency is equivalent to substitute 15 tonnes / ha of chicken manure): K₂,4. Chicken Manure 11.25 tonnes / ha (75% of farmers recommendation) + inorganic fertilizers (N, P, K deficiency replacement dose equivalent to 18.75 tonnes / ha of chicken manure): K₃,5. Chicken Manure,5 tonnes / ha (50% of farmers recommendation) + inorganic fertilizers (N, P, K deficiency replacement dose equivalent to 22.5 tonnes / ha of chicken manure): K₄,6. chicken manure 3.75 t / ha (25% of farmers recommendation) + inorganic fertilizers (N, P, K deficiency replacement dose equivalent to 26.25 tonnes / ha of chicken manure): K₅,7. inorganic fertilizers (N, P, K deficiency replacement dose is equivalent to 30 tonnes / ha of chicken manure): K₆

Based on the research of factors, there are 14 treatment as the experimental unit.

V₁K₀ V₂K₀ V₁K₁ V₂K₁ V₁K₂ V₁K₅ V₂K₅
 V₁K₃ V₂K₃ V₁K₄ V₂K₄ V₂K₂ V₁K₆ V₂K₆

Implementation of the experiment:

Soil sand, chicken manure will be used to analyze the physical and chemical properties before being used in experiments. Prepared polybag planting medium containing 10 kg of sandy soil and chicken manure according to treatment. Furthermore polybags containing growing media drenched with water until it reaches field capacity, and incubated for 2 weeks. Experiments using a planting medium polybags containing 10 kg of soil sand and organic manure, and inorganic appropriate treatment. Furthermore polybags containing growing media drenched with water until moist, and incubated for 2 weeks. There are 42 polybags. Observations of plant growth environment of temperature and humidity of the environment every 1 week using termohigrometer.

Observations of plant growth environment of temperature and humidity of the environment every 1 week using termohigrometer.

OBSERVATIONS:

1) The greenery leaves, measuring the level of greenness of leaves made when the plants were 30, 60 days, by using SPAD

2) The content of chlorophyll

Observations were carried out by means of: leaves that have been stretched perfectly taken 1 g. Pieces of leaves crushed with a mortar, then add 20 ml of 80% acetone.

The solution was allowed to stand for a while. The solution was filtered through Whatman filter paper No. 42. The filtrate was inserted into the cuvette to the boundary then the absorbance was measured with a Shimadzu 1201 spectrophotometer at the λ 645 and 663 nm. (Islam, et al. 2009) Calculation of chlorophyll content was determined by the following formula:

Levels of chlorophyll a = $(12.7 \times A_{663} + 2.69 \times A_{645}) \times (20 \text{ ml} / 1000 \times 1 \text{ g})$

Levels of chlorophyll b = $(22.9 \times A_{645} + 4.68 \times A_{663}) \times (20 \text{ ml} / 1000 \times 1 \text{ g})$

Levels of total chlorophyll = $(20.2 \times 8.02 \times A_{645} + A_{663}) \times (20 \text{ ml} / 1000 \times 1 \text{ g})$

Sampling was carried out to measure chlorophyll content when plants reached maximum vegetative vase

3) flowering (days)

Timing when flowering plants fully blooms on plants that were first observed.

The calculation of interest is the total number of flowers formed on sesame plants and calculated the percentage of interest into the pod and the amount of interest that is not a pod (fall).

4) The number of pods / plant.

Counting the number of pods is done by counting the number of pods formed from plants, and is the pods are harvested as a crop.

5) The weight of a thousand seeds. Weighting of a number of 1000 grain sesame seeds (g)

6) Weight seeds / pod

Calculating the weight of seeds contained in the pods, carried out by the weighing of dry sesame seeds, using the analytical balance.

7) The fresh and dry weight of the roots, stem and leaf from the plant canopy.

Measurement is done by separating the dry weight of plant components (stem, roots, leaves, pods and seeds), to facilitate analysis. Dry weight was obtained after oven plant components at a temperature of 75° C to constant weight (2 x 24 hours)

8) Analysis of the total oil content (%)

Determination of fat content and oil using Soxhlet method, with the following treatments.

3. Results and Discussion

Based on the analysis of variance (analysis of variance) showed that treatment, all factors and interaction were significant. Among the different treatment, application of K₃, for V₁ (Sumberrejo 1) , and K₆ for V₂ (Sumberrejo 2), recorded the tallest plant ,(109 cm and 116 cm) in Table 1.

Growth parameters viz., plant height, number of branches plant⁻¹ , green leaf, chlorophyll, Leaf Fresh Weight., root Fresh Weight, Stem Fresh Weight and dry weight. Growth is a process in

plant life which resulted in changes in the larger sizes that determine crop yield and is due to the interaction between the various internal factors (genetic) and elements of climate, soil, and environmental biology of plants (Rukmana, 1999).

Table 1. Effect of integrated fertilizer on plant height (cm)

		V ₁ (cm)	V ₂ (cm)	K
K	0	93.950 a	94.820a	94.385
	1	99.323bc	100.297bcd	99.810
	2	98.453b	102.387f	100.420
	3	100.553cde	116.993h	108.773
	4	101.133cde	113.423g	107.278
	5	101.547de	108.647f	105.097
	6	109.283f	112.143g	110.713
V		100.606	106.959	
LSD 5%		1.27	1.27	103.782

Description: The treatment followed the same notation in the column indicates not significant by Duncan test at 5%

Plant height in eighth weeks have increased due to fertilizer treatment. it shows the two varieties give the different growth response in the land of sand beach. Effect of integrated fertilizer (organic and inorganic fertilizers) to varieties of the sesame altered significantly due to different treatment in plant height. It is same with Okpara (2007) on sesame research , that the addition of N, and P gives real results in an increase in plant height, number of branches/plant, Leaf Area Index, dry weight and seed yield. the plants to vegetativ accelerate growth of plants / plant height (Morrow, F., 2003)..

Table 2. Average treatment K on any varieties of Green Leaves in 30 days , and 60 days after showed

		V ₁ 30 days	V ₁ 60 days	V ₂ 30 days	V ₂ 60 days	K ₁ 30 days	K ₂ 60 days
K	0	29.327 f	34.367a	27.390e	33.917a	28.358	34.142
	1	30.217g	42.327f	25.343bc	39.240e	27.780	40.783
	2	30.033fg	36.420c	26.653d	36.333c	28.343	36.377
	3	27.737e	36.367c	31.080h	36.103c	29.408	36.235
	4	24.687b	35.237b	29.440f	39.557e	27.063	37.397
	5	22.713a	36.463c	26.583d	33.810a	24.648	35.137
	6	25.437bc	37.500d	25.850c	35.407b	25.643	36.453
LSD 5%		0.509	0.379	0.509	0.379	0.509	36.645
V		27.164	39.954	27.477	36.338	27.321	0.379

Description: The treatment followed the same notation on the V₁ and V₂ column indicates not significant by Duncan test at 5%

2. Green leaf

Though of variance (analysis of variance), the results showed that treatment factors as variety, combination and interaction with a combination of different varieties are significant (table 3)

Table 3. Average treatment K on any varieties for

		V1	V2	K
K	0	4.00bc	3.667b	3.833
	1	5.667d	4.667bc	5.167
	2	5.333cd	2.667a	4.000
	3	3.667b	3.333ab	3.500
	4	4.333bc	4.333bc	4.333
	5	3.667b	3.333ab	3.500
	6	3.667b	2.667a	3.167
V		4.333	3.524	3.929
LSD 5%		0.7	0.7	

Number of Branch

Description: The treatment followed the same notation on the V₁ and V₂ column indicates not significant by Duncan test at 5%

This showed that the kind of combination fertilizer and the kind of varieties will provide nutrients in varying amounts for plants. Increased availability of nutrients in the soil will cause the amount of nutrients absorbed by the plants will be even greater. the K₁ treatment (using chicken manure) it is due to the availability of nutrients in chicken manure are slow release for rooting (Aribawa, IB., *et al.*2004).

3. Number of Branches

Based on the results of variance (analysis of variance) the results showed that treatment factors as variety, combination and interaction with a combination of different varieties are significant.

Number of branches behaved in a similar manner as that of plant height. The recommended dose From Table 5 above can be submitted that among treatment K on Variety 1 and Variety 2 showed significantly different from each other. In Varieties 1, Number of Branches highest observation in treatment combinations (K₁), whereas the second observation, Variety Branch highest amount achieved in the combination treatment (K₁). This shows there is a difference between varieties due to the trend of combination treatment fertilization. Increasing the number of branches due to fertilization with ma-

nure / organic contains besides macro nutrients (NPK), as well as micronutrients, such as Fe, Mg, Zn and Mn which serves as a cofactor of enzymes that boost the body's metabolic activity of the plant (Rizqiani, *et al.* 2007).

4. Flowering

The data depicted that the fastest flowering was recorded in K₆, at 30 until 31.667 days. From Table 6 that among treatment K on Variety 1 and Variety 2 shows the real effect of the observation time of flowering. It can be mentioned that there is a difference between varieties due to the combination of fertilizer treatments on flowering / weeks after planting. The showed that the response Variety 1 is a noticeable difference in the varieties of flowering. It was submitted that the K₅ and K₆ treatment on the flowering varieties 1 provides the fastest results is 30 days, so case in two varieties, the use of an organic fertilizer with increasingly higher doses will produce flowering time is faster than other treatments. Different response is due to the nature of an organic fertilizer can be directly absorbed by the plant seedangkan chicken manure at the beginning of the growth is still mineralization processes before N content can be absorbed by plants, thus giving the effect of a slow (Mulyati, *et al.*,2007).

Table 4. Average treatment K on each variety to Flowering

		V ₁ (days)	V ₂ (days)	K
K	0	41.000	43.000	42.000
	1	37.667	36.667	36.167
	2	34.000	34.667	34.334
	3	32.667	32.333	32.450
	4	31.300	31.333	31.333
	5	30.000	31.333	30.650
	6	30.000	31.667	30.667
V		34.333	35.524	35.929
LSD 5%		0.61	0.61	

Description: The treatment followed the same notation in the column K shows no significant by Duncan test at 5%

Age flowering of a plant closely related to the age of the harvest. Basically, the faster a flowering plant, it will be the longer grain filling phase and the faster the plant can be harvested. The results showed that the fastest flowering date was 30 days, while the longest in the treatment of control, 41-43 days. Environment sesame plants grown on land

Table 5. Average K treatments on each variety for chlorophyll

	Dry -weight/ plant (g)			100 -seed weight (g)			Dry - seed /plant (g)		
	V ₁	V ₂	Average	V ₁	V ₂	Average	V ₁	V ₂	Average
K ₀	7.307	8.920	8.113	0.293	0.267	0.305	10.447	9.797	10.122
1	9.603	11.177	10.390	0.311	0.357	0.334	12.640	12.633	12.637
2	14.927	13.087	14.007	0.350	0.313	0.332	13.703	13.723	13.713
3	11.300	9.677	10.488	0.330	0.313	0.322	12.260	11.967	12.113
4	10.567	9.560	10.063	0.302	0.327	0.314	11.957	12.167	12.062
5	9.427	9.290	9.358	0.267	0.257	0.262	12.350	12.463	12.407
6	8.340	9.230	8.785	0.380	0.410	0.395	11.630	13.167	12.398
V	10.210	10.134	10.172	0.319	0.335	0.327	12.141	12.274	12.207
LSD 5%	0.756	0.756		0.59	0.59		0.89	0.89	

Description: The treatment followed the same notation in the column V₁ and V₂ column indicates not significant by Duncan test at 5%

sand beach with all related to the temperature and nutrient limitations, can affect the crop cycle, which is associated with floral age. High temperatures above the optimum is able to affect the metabolism of flowering plants so much faster. In the treatment of organic fertilizer soil conditions can be improved so that the soil temperature is maintained and not too fast flowering.

5. Chlorophyll

The integrated fertilizer had a significant effect on chlorophyll. The effect of combination treatment factors Fertilizer (K) is relatively diverse, and achieved the highest chlorophyll observations on Fertilizer Combination treatment factor 3 (V₁K₃), as well as the variety is 2, the effect of combination treatment factors affecting fertilizer also diverse in chlorophyll observations, this suggests a different trend differences between varieties due Fertilizer combination treatment. The incident showed that the response Varieties 1 tended to be higher compared with the responses of two varieties of fertilizer combination treatment due to chlorophyll.

Availability of nutrients is very important for plant growth and development, because the nutrient content will help expedite the process of plant metabolic processes such as photosynthesis so high photosynthate produced, which can then be translocated to all parts of the plant will consequently affect the crop yield. When the

flowering of a plant closely related to the age of harvest. Basically the faster a flowering plant, it will be the longer grain filling phase and the faster the plant can be harvested. The results showed that the factor kind of fertilizer, dosage and interactions, providing significantly different results when flowering. El- Habbasha et al. (2008) and Barik and Fulmali (2011) also well established the importance and contribution of organic source of nutrients in enhancing sesame growth and yield.

Table 6. Effect of integrated fertilizer on yield attributes of Sumberrejo 1 and Sumberrejo 2 Sesame

		V ₁	V ₂	Average
K	0	0.11a	0.116a	0.115 z
	1	0.15e	0.162e	0.160 x
	2	0.12b	0.135c	0.130 w
	3	0.170e	0.152d	0.161 x
	4	0.134c	0.133c	0.134 y
	5	0.152f	0.141d	0.141 u
	6	0.134c	0.137c	0.135 y
VLSD 5%		0.145 0.003	0.142 0.003	0.144

Description: The treatment followed the same notation in the column V₁ and V₂ column indicates not significant by Duncan test at 5%

Table 13. Effect of integrated fertilizer on yield attributes of Sumberrejo 1 and Sumberrejo 2 Sesame.

Table 7 The effect integrated fertilizer in total oil content (%)

		V ₁ Oil content (%)	V ₂ Oil content (%)	Average K
K	0	37.873	37.197	37.535
	1	41.720	38.177	39.948
	2	42.210	37.687	39.948
	3	42.727	37.520	40.123
	4	41.220	37.697	39.958
	5	40.340	36.387	38.863
	6	39.983	36.670	38.327
V		41.439	37.619	
LSD 5%		1.47	1.75	39.529

Hasan *et al.* (1999) suggested the development of a test result sesame kinds of local population in Turkey were planted at various locations to determine the quality of sesame oil, obtained results of total oil and fatty acid content varied, so the planting location determines the quality of oil production. While Egbekun and Ehieze (1997), in Nzikou (2009), said that the production of oil products is influenced by crop varieties, seed maturation phase, the system of cultivation and extraction methods were applied.

The existence and essential nutrient contained in manure will increase retention and nutrient that acts as a source of nutrients in the soil that will affect root development. Likewise with the addition of NPK fertilizer sourced from an organic source of nutrients will increase, contributing to the growth of the plant organs and will eventually lead to an increase in the area of photosynthesis, which in turn affects the results of dry matter (Harma, 2011). It was inferred that integrated fertilizer up to 25% (K₃ treatment) could result in highest total oil sesame in Sumberrejo 1 Variety (42.72%).

4. Conclusions

The incorporation of organic material into soil may improve root growth, and proportional NPK (in organic material), in 4. Chicken Manure 11.25 tonnes / ha (75% of farmers recommendation) + inorganic fertilizers (N, P, K deficiency replacement dose equivalent to 18.75 tonnes / ha NPK on K₃ treatments: 1.45 g of urea; 1.25 g SP 36; 0.70 g of KCl, get possible to increase crop

yields (seed yield, 100 seed weight, plant height, number of branches, capsules per plant, seed per capsule, highly nutritive food product (total oil content) with the integrated use of organic and inorganic inputs.

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