Vol. 14, No. 1 (2025): 31 - 38 http://dx.doi.org/10.23960/jtep-l.v14i1.31-38

JURNAL TEKNIK PERTANIAN LAMPUNG

ISSN 2302-559X (print) / 2549-0818 (online)
Journal homepage : https://jurnal.fp.unila.ac.id/index.php/JTP

Effect of Potassium Fertilizer and Humic Acid Doses on Peanut (*Arachis hypogaea*) Yields

Chairunnisa Faza Nabillah[1], Sutini[1,✉], Nora Augustien Kusumaningrum[1]

[1] Department of Agrotechnology, Faculty of Agriculture, Universitas Pembangunan Nasional "Veteran" Jawa Timur, Surabaya, INDONESIA.

Article History:

Received : 12 June 2024
Revised : 24 July 2024
Accepted : 26 July 2024

Keywords:

Humic acid,
KCl,
Peanut,
Potassium,
Yield.

Corresponding Author:
✉ sutini.agro@upnjatim.ac.id
(Sutini)

ABSTRACT

This research aims to determine the best dose of KCl fertilizer and humic acid for peanut yields. The study was conducted using a split-plot design with two factors, and each factor was repeated three times. The dose of KCl as a subplot consisted of 4 levels (0, 50, 75, and 100 kg/ha), while humic acid as the main plot consisted of 4 levels (0, 10, 20, and 30 kg/ha). Observation included the number of non-productive gynophores, the number of pods, dry weight harvest yield (pods per plant, pods per plot, seeds per plant, and seeds per plot), and the weight of 100 seeds. The single factor of KCl dosage significantly affected the dry weight of pods per plant, dry weight of seeds per plant, and dry weight of seeds per plot. The single factor of humic acid treatment had no significant effect on all observation variables, while the interaction of KCl and humic acid doses significantly affected the number of non-productive gynophores and the weight of 100 seeds. The best dosage was 100 kg/ha, producing the highest yield with a dry seed weight per plot of 147.43 g. The combination of KCl 75 kg/ha and humic acid 30 kg/ha produced peanuts with the best quality, with weight 100 seeds of 39.47 g.

1. INTRODUCTION

Peanut (*Arachis hypogaea*) is a leguminous crop commonly cultivated in tropical regions such as Indonesia. Peanuts are one of the most cultivated food commodities by domestic farmers, following rice, corn, and soybeans. As a food crop, peanuts are a source of nutrition due to their content of 25%-30% plant-based protein, 40%-50% fat, 12% carbohydrates, and vitamin B1 (Sembiring *et al*., 2014). The nutritional content of peanuts affects public health, as it influences the quality of the food and feed industries. Peanuts have significant economic potential and high market opportunities, both domestically and internationally, making them suitable for cultivation.

National peanut demand has been increasing yearly due to population growth, which impacts food needs, nutrition, food diversification, and the high demand from industries. However, according to data released by the Kementerian Pertanian (2022), Indonesia's peanut production has fluctuated and has not fully met domestic peanut consumption needs. One solution to increase national peanut production is agricultural intensification by improving cultivation factors with appropriate fertilization that meets crop needs, enabling peanut farming areas to produce higher yields. Fertilization should be tailored to the plant's needs, considering the dosage and type of fertilizer used. Fertilization that falls short of the plant's nutritional requirements will hinder growth and lower the quality and quantity of crop yields. However, over-fertilization will increase fertilizer residue in agricultural soils, altering pH, texture, organic matter content, and water absorption capacity, thereby reducing soil fertility. A solution to increase peanut yields is using potassium as an inorganic fertilizer and adding humic acid as a fertilizer supplement.

KCl (potassium chloride) is a type of inorganic fertilizer containing potassium commonly used by farmers. It is readily available and contains the macronutrient potassium, which plays an important role in enhancing peanut production. Peanuts need potassium to maximize nutrient absorption from the roots and translocate photosynthates from the leaves to all parts of the plant. A lack of potassium may result in the formation of imperfect seeds, leading to reduced peanut yield quality and quantity (Samosir & Pakpahan, 2019). Humic acid can be applied to peanut plants as a fertilizer supplement because it influences plant growth and yields through two mechanisms. First, humic acid enhances nutrient absorption. Second, its composition and content improve the soil's physical properties, making it more friable, which facilitates root movement, nutrient absorption, gas exchange, and water availability (Pibars & Mansour, 2019).

According to Swetha Reddy *et al*. (2020), the application of humic acid can strengthen cell membrane permeability, increasing potassium absorption into plant cells, which in turn raises cell division pressure and boosts cell energy, enhancing the photosynthesis rate. Ismillayli *et al*. (2019) conducted research on the interaction of humic acid with urea (N), SP-36 (P), and KCl (K) using adsorption methods, characterized with Fourier Transform Infrared Spectrophotometry, to determine fertilizer efficiency and supporting materials. There was an interaction between humic acid and K^+ ions (from KCl), evidenced by the shift in initial absorption positions from 3421 cm^{-1}, 1611 cm^{-1}, and 1375 cm^{-1} to 3450 cm^{-1}, 1559 cm^{-1}, and 1379 cm^{-1}. The interaction between potassium and humic acid had the highest fertilizer efficiency compared to N (from urea) and P (from SP-36), with an efficiency value of 90.75%. These studies serve as a reference for combining potassium fertilization with humic acid to maximize potassium absorption, which peanuts need to improve crop yields.

The combination of different doses of KCl fertilizer and humic acid treatments is a promising solution to overcome challenges in peanut cultivation. Discovering the best combination of KCl fertilizer and humic acid doses for peanut plants is expected to help farmers maximize their yields. This research aims to investigate and study the effects of potassium and humic acid on peanuts, both interactively and individually, to identify the best combination or dosage for enhancing peanut production.

2. MATERIALS AND METHODS

2.1. Time and Location of Research

The research was conducted from January to May 2024 in the rice fields of Jambangan Village, Papar District, Kediri Regency, East Java, located at an altitude of 16-30 meters above sea level, with predominantly sandy soil texture. The coordinates of the location are 7°41'24.3"S 112°06'09.9"E.

2.2. Tools and Materials

The tools included shovels, hoes, soil augers, sprayers, and digital scales. The materials used included local peanut seeds, KCl fertilizer, humic acid, base fertilizers (goat manure, urea (N), SP-36 (P)), and pesticide (Relle-brand).

2.3. Experimental Design and Data Analysis

This experiment was arranged using a Split Plot Design (with two treatments: KCl fertilizer application as the subplot and humic acid application as the main plot. The subplot (dose of KCl fertilizer) consisting of 4 levels, namely 0 kg/ha (K0), 50 kg/ha (K1), 75 kg/ha (K2), and 100 kg/ha (K3). The main plot (dose of humic acid), also consisting of 4 levels, namely 0 kg/ha (A0), 10 kg/ha (A1), 20 kg/ha (A2), and 30 kg/ha (A3). Humic acid was applied by pouring. Each treatment was randomized and repeated in three replications (Figure 1). The first replication was closer to the irrigation river, the second replication was in the middle, and the third was closer to the area planted with other crops. The observation data obtained were analyzed using variance analysis (ANOVA) with a linear model, and if significant effects were found, the 5% HSD (Honestly Significant Difference) test was applied.

2.4. Land Preparation

The research began with tilling the soil using hoes to loosen the soil and break the weed life cycle. The soil was arranged into beds measuring 0.6 m wide, 3.6 m long, and about 40 cm high. Drainage channels and paths for crop care were made between the beds. After the beds were formed, goat manure (500 g/plot), SP-36 (5 g/plot), and urea (5 g/plot) were applied as base fertilizers, and the land was left for three days before planting.

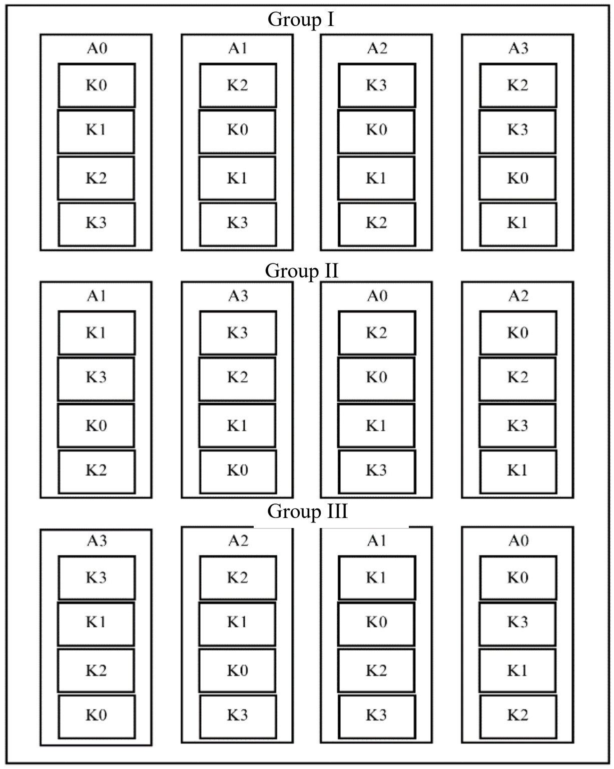

Figure 1. Experimental layout

2.4.1. Planting

Planting was carried out in the morning using the dibble method, where holes about 5 cm deep were made in the soil. Two seeds were placed in each hole and then covered with a thin layer of soil. Thinning was done at 7 days after planting (DAP), leaving the best plant in each hole. The planting distance was 25 x 30 cm, with 6 plants per plot, where 3 plants were used as the main sample, and 3 were reserved as backup plants.

2.4.2. Maintenance

Main irrigation relied on rainwater, but if there was no rain for 7 days and the soil appeared dry, irrigation was done using river water. Leaf caterpillar attacks were controlled using Relle pesticide by spraying. Mounding was carried out at 30 DAP (after flowering) and again at 45 DAP.

2.4.3. Application of KCl

KCl was applied at doses of 0 kg/ha, 50 kg/ha, 75 kg/ha, and 100 kg/ha in three stages: 25% of the total dose was applied at 10 DAP, another 25% at 25 DAP, and the remaining 50% at 40 DAP by drilling a hole 3 cm away from the stem and covering the fertilizer with a thin layer of soil.

2.4.4. Application of Humic Acid

Humic acid was applied at doses of 0 kg/ha, 10 kg/ha, 20 kg/ha, and 30 kg/ha by dissolving each dose in 1 liter of water, which was then poured around the plants. Humic acid was applied twice, with equal doses: the first application at 10 DAP and the second at 25 DAP.

2.4.5. Harvesting

Harvesting was done at 85 DAP or when the plants showed physiological signs of being ready for harvest. Harvesting was done manually, and the peanut pods were cleaned of soil before separating the pods from the rest of the plant.

2.4.6. Observation Parameters

In this study, the parameters observed to support the yield and the peanut yield itself included: the number of non-productive gynophores, the number of pods, yield (pod weight per plant, pod weight per plot, seed weight per plant, and seed weight per plot), and the weight of 100 randomly selected seeds from the 3 sample plants.

3. RESULTS AND DISCUSSION

3.1. Number of Non-Productive Gynophores

Non-productive gynophores are gynophores that fail to form pods. The variance analysis of the number of non-productive gynophores showed a significant interaction between KCl fertilizer and humic acid doses in peanut plants. The average number of non-productive gynophores for each combination of KCl and humic acid doses, after the 5% HSD test, is presented in Table 1.

The interaction between KCl fertilizer and humic acid doses affected the non-productive gynophore variable. The highest number of non-productive gynophores was found in the K0A2 (KCl 0 kg/ha and humic acid 20 kg/ha) interaction with 137 gynophores, followed by K2A1 (KCl 75 kg/ha and humic acid 10 kg/ha) with 135.57 gynophores, and K2A3 (KCl 100 kg/ha and humic acid 30 kg/ha) with 131.78 gynophores. These were not significantly different from K3A1 (KCl 100 kg/ha and humic acid 10 kg/ha), which had 120 non-productive gynophores.

Table 1. Average number of non-productive gynophores in peanut plants based on KCl and humic acid treatments

KCl dose	Humic acid dose			
	A0	**A1**	**A2**	**A3**
K0	123.33 ef	62.43 a	137 f	80.78 b
K1	89.67 bc	78.78 ab	109.89 de	83.11 b
K2	111.67 de	135.57 f	86.57 bc	131.78 f
K3	82 b	120 ef	100 cd	109.11 de
HSD 5%			52.35	

Note: Numbers with the same letters indicate no significant difference based on the 5% HSD test; ns = not significant.

The formation of non-productive gynophores is caused by several factors, namely: (1) the number of non-productive gynophores formed is influenced by nutrient availability. This is because when macro-nutrients in compound fertilizers form the right composition to support the development of vegetative organs, it also supports the formation of other generative organs (Gulo *et al*., 2022); (2) the inability of the gynophore to form pods due to the distance being too far from the soil, making it unable to penetrate the soil surface. This is in line with Hidayat & Suwitono (2018), who stated that the process of pod formation would be easier when the gynophore is not too far from the soil surface; (3) the plant growth phase during the flowering stage is not simultaneous, resulting in late-blooming flowers causing a slight delay in the entry of the gynophore into the soil (Kasno *et al*., 2015).

A high number of non-productive gynophores can increase peanut yield if periodic hilling is done to facilitate the gynophore tip in the pod formation process and the application of potassium fertilizer as a nutrient supply for pod formation. Peanuts require potassium nutrients, and the higher the availability of potassium in the soil during the pod-filling process, the smoother the process will be, and the proportion of gynophores forming pods will increase (Prayuda *et al*., 2023).

3.2. Number of Pods

The variance analysis (ANOVA) showed no significant interaction between KCl fertilizer and humic acid doses on the number of pods per peanut plant. Similarly, individual doses of KCl and humic acid had no significant effect on the number of pods per plant. The average number of pods per plant based on KCl and humic acid dose combinations is presented in Table 2. The application of KCl fertilizer at doses ranging from 0 kg/ha to 100 kg/ha and humic acid at doses ranging from 0 kg/ha to 30 kg/ha did not yield significant differences in the number of pods per peanut plant. The highest number of pods was observed at a KCl dose of 100 kg/ha, but it was not significantly different from other doses. Similarly, the highest number of pods for humic acid was found at 20 kg/ha, but this was not significantly different from other doses.

Table 2. Effect of KCl and humic acid treatments on the average number of pods in peanut

KCl treatment	Number of pods
K0	44.47
K1	38.61
K2	47.08
K3	48.00
HSD 5%	ns

Humic acid treatment	Number of pods
A0	44.55
A1	42.05
A2	46.63
A3	44.91
HSD 5%	ns

The study by Sugianto *et al*. (2022) on black soybeans using KCl doses of 65 kg/ha, 85 kg/ha, and 105 kg/ha also showed no significant response, with the highest pod number found at 65 kg/ha (78.80 pods). Bekti Indra *et al*. (2019) found that 15 l/ha of humic acid was the most effective dose for increasing the number of peanut pods, compared to 0 l/ha, 30 l/ha, and 40 l/ha. The differences in humic acid effectiveness between studies may be due to variations in soil quality, the type of humic acid used, the tested doses, and plant responses. Humic acid functions as a supplement to fertilization and a soil conditioner. If the soil in the research location is already optimal, humic acid may not have a significant independent effect.

3.3. Yield

No interaction was found between the KCl and humic acid treatments on yield parameters. However, the individual application of KCl had a significant effect on dry pod weight per plant, dry seed weight per plant, and dry seed weight per plot, but not on dry pod weight per plot. Humic acid, as a single treatment, had no significant effect on yield parameters. The yield parameters are presented in Table 3. The treatment of KCl doses affected the plant yield parameters, namely pod weight per plant, seed weight per plant, and seed weight per plot. The parameter of pod weight per plot was the only yield parameter that did not show a significant difference with KCl fertilization and was inversely proportional to the seed weight per plot parameter. This may be due to differences in the number of pods and pod sizes formed between plots, the comparison of seed weights between plots, and the comparison of seed quality formed between plots.

Table 3. Peanut yield (gam dry pod per plant) under KCl and humic acid treatments

Treatment	g dry pod per plant	g dry pod per plot	g dry seed per plant	g dry seed per plot
K0	32.72 ab	204.31	22.28 ab	120.17 a
K1	31.49 a	200.47	21 a	123.46 ab
K2	39.46 b	225.72	27.72 b	144.30 ab
K3	38.44 ab	236.31	26.21 ab	147.43 b
HSD 5%	7.54	ns	5.88	25.74
A0	36.89	223.56	25.86	136.81
A1	33.13	202.67	22.60	123.86
A2	35.93	216.26	24.28	133.11
A3	36.16	224.32	25.16	141.58
HSD 5%	ns	ns	ns	ns

Note: Numbers with the same letters indicate no significant difference based on the 5% HSD test; ns = not significant.

The application of potassium fertilizer is related to the increased supply of K^+ ions, which affects the balance and availability of nutrients in the soil. Potassium is an essential nutrient required for the seed formation process, and potassium, in collaboration with phosphorus, functions as a regulator of the plant's metabolic mechanisms (Siregar *et al*., 2021). Based on the research, a KCl fertilizer dose of 75 kg/ha provided the best results for pod weight per plant

(39.46 grams) and seed weight per plant (27.72 grams). These results are consistent with Ali *et al*. (2019), where the application of 75 kg/ha potassium on corn plants resulted in the best outcomes for plant height and grain yield (kernel weight per cob, thousand kernel weight, total kernel weight, and harvest index). Potassium doses exceeding 75 kg/ha showed a slight decrease in corn yields. Another study conducted by Karimuna & Amin (2014) showed that the application of 75 kg/ha KCl fertilizer combined with 2.5 tons/ha of straw in rice plants resulted in the best yield for harvested dry grain.

The seed weight per plot parameter showed that a KCl fertilizer dose of 100 kg/ha provided the best result with a seed weight of 147.43 g. This research is consistent with Arini *et al*. (2022), who reported that applying potassium fertilizer at a dose of 100 kg/ha produced the best seed weight per plot in mung beans. Another study by Maryani (2021) showed that applying 100 kg/ha potassium fertilizer resulted in significantly higher fresh and dry biomass per plant in sweet corn compared to the 50 kg/ha KCl dose.

Higher KCl fertilization does not guarantee better responses or higher yields in plants. According to Nuryani *et al*. (2019), increasing fertilizer doses will not always result in increased crop yields, especially after the fertilization dose reaches an optimal point. It is suspected that high-dose fertilizer use increases the concentration of nutrient solutions in the soil, making nutrient absorption by roots more difficult. Optimal plant growth and production occur when existing supporting factors match the plant's needs, such as nutrients being available in balanced amounts, the fertilization dose being appropriate, and the necessary nutrients being available for the plants. This results in a potassium fertilizer dose of 75 kg/ha being more effective than 100 kg/ha for certain parameters.

Another fact shows that potassium often becomes a limiting factor in cultivation because K is highly sensitive to leaching, especially in tropical regions with high rainfall (Uke *et al*., 2015). Moreover, this study was conducted during the rainy season (January-May), which may have led to higher potassium leaching compared to the dry season. This could be a limiting factor in potassium fertilization in this study, as the dry weight parameters of pod per plant and seed per plant at a KCl dose of 50 kg/ha were lower but not significantly different, with a weight difference of less than 2 g compared to the 0 kg/ha KCl dose.

The results of the study show that the single factor application of humic acid did not significantly affect all yield parameters (pod weight per plant, pod weight per plot, seed weight per plant, seed weight per plot). Similar results were also reported by Setyawan & Setyawan (2020), who stated that humic acid alone did not significantly affect the overall growth and yield parameters of soybean plants. Research by Maibodi *et al*. (2015) stated that the fresh and dry weight of plants, leaf chlorophyll content, and fresh root weight of weeds were not affected by the application of humic acid.

This is likely because humic acid acts as a supplementary fertilization material, and in this study, other elements were needed to influence the observed parameters of peanut plants. This statement is supported by Ulfa *et al*. (2020), who stated that humic acid can bind available nutrients, making it easier for plant roots to absorb nutrients. Humic acid can also improve soil properties, leading to increased nutrient uptake by plants, which impacts plant growth and production. Their research showed that humic acid treatment can optimize NPK uptake in corn plants.

3.4. Weight of 100 Seeds

The analysis of variance (ANOVA) on the observation parameter of the weight of 100 seeds in grams showed a significant interaction between the doses of KCl fertilizer and humic acid on peanut plants. The weight of 100 peanut seeds after being tested with HSD 5% is presented in Table 4. The interaction between KCl fertilizer and humic acid doses responded to the research variable of 100-seed weight. Based on the research, the highest 100-seed weight with notation "e" was found in the K2A3 interaction (KCl 75 kg/ha and humic acid 30 kg/ha) at 39.47 grams, and K3A2 (KCl 100 kg/ha and humic acid 20 kg/ha) at 38.43 grams, while the lowest average 100-seed weight was found in the K0A0 interaction (KCl 0 kg/ha and humic acid 0 kg/ha) at 25.2 grams.

The weight of 100 seeds is an indication of the quality of the harvest produced by the plant; the larger the 100-seed weight value, the higher the harvest quality. Potassium is absorbed in the form of K^+ ions and moves freely within the plant (Hendrival *et al*., 2014). Potassium positively influences crop yields and quality because it plays a role in carbohydrate and protein formation. This aligns with Wibowo *et al*., (2020), who stated that potassium functions for plants in carbohydrate formation and mobilization, protein synthesis catalysis, increasing carbohydrate and sugar levels, and enhancing fruit quality in terms of shape, content, and color. Therefore, a deficiency in potassium during seed formation can reduce the quality of peanut seeds in terms of shape, weight, and size.

Table 4. Weight of 100 peanut seeds for the combination of KCl fertilizer and humic acid treatments

Treatment			**Humic Acid**	
KCl	**A0**	**A1**	**A**	**A3**
K0	25.2 a	29.27 b	26.87 a	29.97 bc
K1	29.33 bc	29.33 b	29.8 bc	32.87 d
K2	29.9 bc	29.8 bc	29.67 bc	39.47 e
K3	31.37 bcd	31.73 cd	38.43 e	31.4 bcd
HSD 5%			7.26	

Note: Numbers with the same letter indicate results that are not significantly different in the HSD 5% test; ns = not significant.

According to Mukhlisin & Rohmaiyah (2023), humic acid optimizes the plant's absorption of nutrients like K, P, Cu, Mg, Zn, and Na, making it useful for optimizing fertilization. The use of 30 kg/ha of humic acid increases the 100-seed weight of peanuts when interacting with KCl at 75 kg/ha, and 20 kg/ha of humic acid optimizes the 100-seed weight of peanuts when interacting with KCl at 100 kg/ha. The K0A0 combination (KCl 0 kg/ha and humic acid 0 kg/ha) produced the lowest 100-seed weight, likely due to the limited potassium supply as a protein catalyst.

4. CONCLUSION

The conclusion of this research is that the single treatment of KCl fertilization dose affects the dry weight of peanut pods per plant, with the 75 kg/ha dose yielding the best weight of 39.46 grams. The dry seed weight per plant was best at 27.72 grams with the 75 kg/ha dose, and the dry seed weight per plot was best at 147.43 grams with the 100 kg/ha dose, showing significantly different results. The single treatment of humic acid application did not significantly affect all peanut crop production parameters. The interaction of KCl fertilizer and humic acid doses significantly affected the number of non-productive gynophores, with the KCl 0 kg/ha and humic acid 20 kg/ha combination producing 137 sterile gynophores. The best 100-seed weight was found in the KCl 75 kg/ha and humic acid 30 kg/ha combination, at 39.47 grams. Future research should consider changing the humic acid selection to a liquid type and combining it with other types of potassium fertilizers for comparative research results.

REFERENCES

Ali, S., Inamullah, Arif, M., Ali, M., Iqbal, M.O., Munsif, F., & Khan, A. (2019). Maize productivity as influenced by potassium under reduced irrigation regimes. *Sarhad Journal of Agriculture*, ***35***(1), 171-181. https://doi.org/10.17582/journal.sja/2019/35.1.171.181

Arini, N., Ariyanto, S.E., & Latief, M.I., (2022). Pengaruh dosis kompos kotoran sapi dan pupuk kalium terhadap pertumbuhan dan hasil tanaman kacang *(Vigna radiata* L.). *MJ-Agroteknologi*, ***1***(2), 22–26. https://doi.org/10.24176/mjagrotek.v1i2.8988

Bekti Indra, B., Purnamasari, R.T., & Pratiwi, S.H. (2019). Pengaruh dosis asam humat terhadap pertumbuhan dan hasil tanaman kacang tanah *(Arachis hypogea* L.). *Agrosaintifika: Jurnal Ilmu-Ilmu,* ***2***(1), 98–102. https://doi.org/10.32764/agrosaintifika.v1i2.758

Gulo, Y.S.K., Halawa, E., & Manurung, A.I. (2022). Pengaruh pemberian pupuk NPK dan jumlah biji per-tiap lubang tanam yang mempengaruhi pertumbuhan serta produksi kacang tanah varietas Tasia I (*Arachis hypogaea* L.). *Jurnal Agrotekda*, ***6***(2), 21-40.

Hendrival, Latifah, & Idawati. (2014). Pengaruh pemupukan kalium terhadap perkembangan populasi kutu daun *(Aphis glycines Matsumura)* dan hasil kedelai. *Jurnal Floratek*, ***9***(2), 83-92.

Hidayat, Y., & Suwitono, B. (2018). Kelayakan usahatani varietas unggul kacang tanah di Kabupaten Halmahera Utara. *Jurnal Pengkajian dan Pengembangan Teknologi Pertanian*, ***21***(2), 127-136.

Ismillayli, N., Kamali, S.R., Hamdiani, S., & Hermanto, D. (2019). Interaksi asam humat dengan larutan urea, SP-36 dan KCl dan pengaruhnya terhadap efisiensi pemupukan. *Jurnal Pijar Mipa*, ***14***(1). https://doi.org/10.29303/jpm.v14i1.815

Karimuna, L., & Amin. (2014). Kajian pemupukan kalium dengan aplikasi jerami paditerhadap pertumbuhan dan produksi padi sawah pada lahan sawah bukaan baru di Kabupaten Buton, Sulawesi Tenggara. *Jurnal Agroteknos*, ***4***(3), 180–188.

Kasno, A., Rahmianna, A.A., Mejaya, I.M.J., Harnowo, D., Purnomo, S., & Winarto, A. (2015). *Kacang tanah: inovasi teknologi dan pengembangan produk*. Malang: Balai Penelitian Tanaman Aneka Kacang dan Umbi.

Kementrian Pertanian. (2022). *Laporan Kinerja Direktorat Jenderal Tanaman Pangan*.

Maibodi, N.D.H., Kafi, M., Nikbakht, A., & Rejali, F. (2015). Effect of foliar applications of humic acid on growth, visual quality, nutrients content and root parameters of perennial ryegrass *(Lolium perenne* L.). *Journal of Plant Nutrition*, ***38***(2), 224–236. https://doi.org/10.1080/01904167.2014.939759

Maryani, Y. (2021). Respon tanaman jagung manis *(Zea mays* saccharata sturt) terhadap rizobakteria dan pupuk kalium. *Jurnal Pertanian Agros*, ***23***(2), 2827-2846.

Mukhlisin, I., & Rohmaiyah, L.N. (2023). Optimalisasi pemberian unsur hara npk dan asam humat pada produktivitas kacang hijau *(Vigna radiata* L.). *Agropross: National Conference Proceedings of Agriculture*, 511-517. https://doi.org/10.25047/agropross.2023.504

Nuryani, E., Haryono, G., & Historiawati. (2019). Pengaruh dosis dan saat pemberian pupuk P terhadap hasil tanaman buncis *(Phaseolus vulgaris* L.) tipe tegak. *Jurnal Imu Pertanian Tropika dan Subtropika*, ***4***(1), 14-17.

Pibars, S.K., & Mansour, H.A. (2019). Effect of tillage management practices and humic acid applications on some engineering properties of peanut. *Plant Archives*, ***19***(1), 636-643.

Prayuda, A., Umarie, I., & Suroso, B. (2023). Potensi pertumbuhan dan hasil tanaman kacang tanah *(Arachis hypogeae* L.) terhadap inokulasi rhizobium dan pupuk kandang kambing. *Callus: Journal of Agrotechnology Science*, ***2***(2), 11-33. https://journal.pubmedia.id/index.php/Callus/article/view/2312

Samosir, O.M., & Pakpahan, T.W. (2019). Respon pertumbuhan dan produksi kacang tanah (A*rachis hypogaea* L.) terhadap pemberian paclobutrazol dan pupuk kalium. *Agrotekda*, ***3***(1), 28-37. http://jurnal.darmaagung.ac.id/index.php/agrotekda/article/view/251

Sembiring, M., Sipayung, R., & Sitepu, F.E. (2014). Pertumbuhan dan produksi kacang tanah dengan pemberian kompos tandan kosong kelapa sawit pada frekuensi pembumbunan yang berbeda. *Jurnal Online Agroekoteknologi*, ***2***(2), 598–606.

Setyawan, F., & Setyawan, F. (2020). Pengaruh sp-36 dan asam humat terhadap pertumbuhan dan produksi tanaman kedelai *(Glycine max* L). *Buana Sains*, ***19***(2), 1–6. https://doi.org/10.33366/bs.v19i2.1742

Siregar, J., Halawa, R., & Samosir, O.M. (2021). Pengaruh pemberian pupuk kandang sapi dan kalium terhadap pertumbuhan dan produksi kacang tanah (*Arachis hypogaea* L.). *Jurnal Agrotekda*, ***5***(1), 54-67. http://jurnal.darmaagung.ac.id/index.php/agrotekda/article/view/1386

Sugianto, Sutejo, & Bahri, S. (2022). Respon tanaman kedelai hitam (*Glycine max* L) terhadap dosis kasgot dan pupuk kalium (KCl). *Jurnal Agro Silampari*, ***11***(1), 28-36. http://www.ejurnal.unmura.org/index.php/jurnalagrosilampari/article/view/55

Swetha Reddy, K., Bhuvaneswari, R., & Karthikeyan, P.K. (2020). Effect of DAP, humic acid and micronutrient mixture foliar application on yield and quality characters of groundnut *(Arachis hypogaea* L.) var. TMV 7 in sandy loam soil. *Plant Archives*, ***20***(1), 521-525.

Uke, H.Y., Barus, H., & Madauna, I.S. (2015). Pengaruh ukuran umbi dan dosis kalium terhadap pertumbuhan dan hasil produksi bawang merah *(Allium Ascalonicum* L.) varietas lembah palu. *Jurnal Agrotekbis*, ***3***(6), 655-661.

Ulfa, F., Ridwan, I., Mustari, K., Dachlan, A., Iswoyo, H., & Hasmi. (2020). Higher NPK nutrients absorption due to the use of humic acid affects the growth and yield of baby corn applied with mungbean extract. *IOP Conference Series: Earth and Environmental Science*, ***575***(1), 1–6. https://doi.org/10.1088/1755-1315/575/1/012125

Wibowo, A.S., Septianti, S.D., & Widodo, L.U. (2020). Pembuatan pupuk cair kalium silika berbahan baku abu daun bambu. *ChemPro*, ***1***(01). https://doi.org/10.33005/chempro.v1i01.30