JPPIPA 10(12) (2024)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

The Effect of doses of Natural Super Phospate Fertilizer and Potassium on the Growth and Yield of Peanut Plants *(Arachis hypogaea* L.)

Husainah Yusuf[1*], Jailani[2], Evi Apriana[2], Elvitriana[3], Ruhul Maghfirah[4]

[1] Agrotechnology Study Program, Faculty of Agriculture, Universitas Gunung Leuser, Aceh Tenggara, Indonesia.
[2] Biology Education, Faculty of Teacher Training and Education, Universitas Serambi Mekkah, Banda Aceh, Indonesia.
[3] Environmental Engineering Study Program, Faculty of Engineering, Universitas Serambi Mekkah, Banda Aceh, Indonesia.
[4] Faculty of Mathematics and Natural Sciences, Universitas Syiah Kuala, Banda Aceh, Indonesia.

Received: June 01, 2024
Revised: September 14, 2024
Accepted: December 25, 2024
Published: December 31, 2024

Corresponding Author:
Husainah
husainahyusuf5@gmail.com

DOI: 10.29303/jppipa.v10i12.7898

Abstract: The purpose of the study was to determine the proper dosage of natural phosphate and potash fertilizers for peanut growth and yield. This research was conducted in Tanjung Village, Darul Hasanah District, Southeast Aceh Regency from October to December 2020. This study used 3x3 factorial randomized block design (RBD) with 3 repeats. The results showed that the dose of Natural Super Phosphat fertilizer had a significant effect on the weight of 100 dry seeds of peanut plants. The highest growth and soaking of dried peanut seeds tends to be obtained at a dose of Natural Super Phospat 100 kg P205 I ha. The dose of potash fertilizer had no significant effect on plant height at the age of 15, 30 and 45 watersheds, the number of well-fused pods per clump, the number of empty pods per clump, the weight of dry pods per clump, the weight of 100 dry seeds, the weight of dry seeds per net plot and the weight of dry seeds per hectare. Better growth and yield of dry seeds in peanut plants tend to be obtained with a dose of potash fertilizer of 75 kg K20 I ha. There is an insignificant interaction between the dose treatment of Natural Super Phosphate fertilizer and the dose of potassium fertilizer.

Keywords: *Arachis hypogaea*. L; Fertilizer; Natural; Potash fertilizer; Super phospate

Introduction

Food is an important commodity for the survival of society. In many regions around the world, food insecurity and poor supplies threaten communities and their survival. In developing countries, the main objective is to encourage the development and use of underutilized legumes so as to strengthen food security and nutrition while meeting global food demand. Many underutilized legume vegetables are rich in minerals, proteins, and vitamins to achieve nutritional security. The exploration and promotion of these neglected legume crops relies on several factors, including coordinated research, production, and global awareness to revive interest in underutilized legume crops (Mateva et al., 2023).

This article is important because it examines the effect of doses of natural superphosphate fertilizer and potassium on the growth and yield of peanut plants (Arachis hypogaea L.), which have high economic value and play a crucial role in food security. The study aims to find the optimal fertilizer dose to enhance peanut productivity, which can help farmers achieve better and more efficient harvests. The results of this research can serve as a guide for farmers and other agricultural practitioners to use fertilizers precisely, reduce waste, and maximize production without harming the environment.

How to Cite:
Yusuf, H., Jailani, Apriana, E., Elvitriana, & Maghfirah, R. (2024). The Effect of doses of Natural Super Phospate Fertilizer and Potassium on the Growth and Yield of Peanut Plants (Arachis hypogaea L.). *Jurnal Penelitian Pendidikan IPA*, *10*(12), 10013–10019. https://doi.org/10.29303/jppipa.v10i12.7898

Peanuts (A. hypogaea L.) are the main source of livelihood for many smallholder farmers in tropical and subtropical regions (Mekdad, El-Enin, et al., 2021). Peanuts have a source of protein, calories, essential fatty acids, vitamins, and minerals that are very valuable for human nutrition (Willett et al., 2019). In addition, peanut seeds are an excellent source of α-tocopherol (vitamin E), containing about 0.8% by weight (Canavar, 2015). Peanut consumption is reportedly associated with several health benefits (Guasch-Ferré et al., 2017). Indeed, a recent publication published by the Lancet concludes that the transformation towards healthy eating by 2050 requires major dietary changes, including a more than 100% increase in consumption of healthy foods, such as nuts, fruits, vegetables, and legumes (Willett et al., 2019). Higher consumption of total and specific types of nuts was found to be inversely associated with total cardiovascular disease and coronary heart disease (Guasch-Ferré et al., 2017). Qualified health claims linking early introduction of peanuts and a reduced risk of peanut allergy have been recognized by the Food and Drug Administration (FDA) (FDA, 2017).

Peanuts are a rich source of dietary protein with the ability to meet up to 46% of the recommended daily allowance; essential vitamins are mainly E, energy from oils and fats, and dietary fiber. It is also a rich source of minerals such as K, Na, Ca, Mn, Fe, and Zn and is rich in biologically active compounds (arginine, resveratrol, phytosterols, and flavonoids) (Ojiewo et al., 2020).

In Indonesia, peanut plants have become a commodity of strategic value (Farasmayuda et al., 2023). Food crops are a group of plant sources of carbohydrates, proteins, one type of superior food crop is the legume group legumes most of the new peanuts are used for household food such as: boiled beans, fried beans, cooking spices, and other snacks. Actually, peanuts have the potential to be processed in the food industry into various processed food products such as: various cakes, vegetable milk, high protein flour, ice cream, and vegetable oils (Taufiq et al., 2015). Peanuts (Arachis hypogeaL.) are one of the most consumed oilseeds worldwide. It belongs to the legume family and has spread to other parts of the world from South America (Çiftçi et al., 2022).

Peanut production is the result of the calculation of the projected area of harvest and production, peanut production in 2019 amounted to 4,498.53 tons then in 2020 peanut production decreased by 4,439.03 tons and in 2021 experienced an increase in production compared to the previous year, in 2021 peanut production reached 4,703.12 tons. The problem of ups and downs in production yields is caused by the area of peanut harvest each year and also the lack of availability of macro and micro nutrients in the soil (BPS, 2022).

Given the importance of peanuts in the Indonesian economy and their great benefits for the health of the human body, it is appropriate that peanut production needs to be increased. The effort taken is to carry out an excisation program supported by intensification efforts. In addition, judging from the agro-climatic aspect, Indonesia has the potential to cultivate peanuts, as well as from the technical, economic and social aspects, it is very supportive (Abidin, 2022).

Peanut planting in Indonesia has bright prospects because its growth is very suitable in equatorial areas, namely with high irradiation intensity and not too high bulk. This plant can grow in lowlands as well as in highlands up to an altitude of 500 meters above sea level. Factors that limit crop productivity, continuous planting of crops without proper fertilizer supply will reduce soil fertility (Fujisao et al., 2020).

In arid and semi-arid regions, food crops face many environmental enemies that adversely affect their performance (Alharby et al., 2021; Azzam et al., 2021; Desoky et al., 2021; ElSayed et al., 2020; Mekdad, Rady, et al., 2021; Mekdad et al., 2016; Rady et al., 2019, 2021; Rehman et al., 2021; S. Taha et al., 2020; Seleiman et al., 2020). Given the importance of peanut plants as food crops for humans and animals, their medicinal properties, and their economic importance to farmers/producers, urgent solutions must be found to increase peanut productivity in adverse environmental conditions such as poor soil fertility and abundance of weeds.

Fertilizer is a vital means of production that is closely related to efforts to meet food needs. Fertilizers contribute 20% to the increase in agricultural production. Excessive application of chemical fertilizers will adversely affect the physical condition of the soil. Efforts to restore soil fertility can apply organic fertilizers is the best solution. Organic fertilizers used in organic farming systems can be in the form of green manure, compost, animal manure, agricultural waste, household waste, and even industrial waste, both in the form of solid and liquid fertilizers (Pujiastuti et al., 2021).

Method

This research was conducted in Tanjung Village, Darul Hasanah District, Southeast Aceh Regency from October to December 2020. The ingredients used in this study are the peanut seeds used were seeds of local varieties as much as 856 g. The Natural Super Phosphate fertilizer used is SP-36 fertilizer as much as 844g. The potash fertilizer used is KCI fertilizer (60% K20) as much as 506 g. As the basic fertilizer used is manure derived

from cow dung that has been composed of sempuma 81 kg (equivalent to 20 tons/ha). To control pest and disease attacks, insecticide Sevin 85 S and fungicide Dithane M-45 are used, each with a concentration of 2 g/ 1 water.

The tools used in this study are: hoe, rake, raffia rope, meter, analytical scale, tugal, drill, I: ansprayer, and stationery.

Experiment Design

The experimental design used in this study was a Group Randomized Design (RAK) 3 x 3 factorial pattern with 3 repeats. There are two factors studied, namely the fertilizer dosage factor consists of 3 levels, Pl = 50 kg P205/ha setara 139 kg SP-36/ha (20.85 g SP-36/plot), P2 = 75 kg P205/ha setara 208 kg SP-36/ha (31.2 g SP-36/plot), P3 = 100 kg P205/ha setara 278 kg SP-36/ha (41.7 g SP-36/plot).

The second factor is the dose of potash fertilizer which consists of 3 levels, Kl = 50 kg K.20/ha equivalent to 83 kg KCI/ha (12.45 g KCl/plot), K2 = 75 kg K.20/ha equivalent to 125 kg KC!/ha (18.75 g KCl/plot), K3 = 100 kg K.20/ha equivalent to 167 kg KCI/ha (25.05 g KCI/plot).

Thus there were 9 treatment combinations and 27 experimental units. The data were analyzed by F test, the maternatics model used was:

$$Yijk = \mu + Pi + Pj\ t\ Kk + (PK)jk + eijk \quad (1)$$

Where:

Yijk = Results of observations of doses of Natural Super Phosphate fertilizer (P) at the j-th level and doses of Potassium fertilizer (K) at the k-th level of the i-th repeat
μ = average
i = Effect of i-th repetition (i = 1,2, and 3)
Pj = The effect of the dose of Super Natural Phosphate (P) fertilizer at the j-th level
G = 1, 2, and 3)
Kk = The effect of potassium fertilizer dose (K) on the k-th level (k = I, 2, and 3)
(PK) jk = Interaction of the dose of Natural Super Phosphate fertilizer (P) at the j-th level with the dose of potassium fertilizer (K) at the k-th level

Result and Discussion

Effect of Natural Super Phospate Fertilizer Dosage

Peanuts or peanuts (Arachis hypogaea L.) are the main oil-seeded legumes grown in subtropical and tropical regions (Jha et al., 2016). Peanuts are a rich source of oil (40–60%), protein (10–20%), carbohydrates, vitamins, minerals, antioxidants, and monounsaturated fatty acids, as well as a source of important compounds in medicine (Gundaraniya et al., 2020). Peanuts (Arachis hypogaea L.) are an important and economical oil, food and feed crop for the world. Originating in the Central American region, spreading to other regions of the world, and developing in almost all tropical and subtropical countries (El-sherbeny et al., 2023).

The results of test F in variety analysis showed that the dose of Natural Super Phospat fertilizer had a significant effect on the weight of 100 dry seeds but had no real effect on plant height aged 15, 30 and 45 HST, the number of pithy pods per clump, the number of hollow pods per clump, the weight of dry pods per clump, the weight of dry seeds per net plot and the weight of dry seeds per hectare.

The average value of growth modifiers and yield of peanut plants observed due to the dose treatment of Natural Super Phospat fertilizer showed that the highest plants aged 15, 30 and 45 HST tended to be obtained at the dose treatment of Natural Super Phospat fertilizer l00 kg P205 (P3) although statistically different was not real with the dose treatment of Natural Super Phospat fertilizer 50 kg P205 / ha (Pl) and 75 kg P205 / ha (P2).

The highest number of pithy pods per clump tended to be obtained at the dose treatment of Natural Super Phospat fertilizer l00 kg P205/ha (P3), although statistically it was not real from the dose treatment of Natural Super Phospat fertilizer 50 kg P205/ha (Pl) and 75 kg P205/ha (P2), while the highest number of hollow pods per clump tended to be obtained at the dose treatment of Natural Super Phospat fertilizer 50 kg P205/ha (Pl), although statistically different was not real with the treatment dose of Super Phospat Alam fertilizer 75 kg P205/ha (P2) and 100 kg P205/ha (P3).

The highest dry pod weight per clump tended to be obtained at the dose treatment of 75 kg P205/ha (P2) of Natural Super Phospat fertilizer although statistically it was not significantly different from the dose treatment of 50 kg Natural Super Phospat fertilizer P2Q5/ha (P1) and 100 kg P205/ha (P3).

The highest weight of 100 dry seeds was obtained at the dose treatment of Natural Super Phospat fertilizer 100 kg P205/ha (P3) which was significantly different from the treatment of the dose of Natural Super Phospat fertilizer 75 kg P205/ha (P2) but was not significantly different from the dose treatment of Natural Super Phospat fertilizer 50 kg P205/ha (Pl), then between the treatment of Pl and P2 was not real. The highest dry seed weight per net plot and dry seed weight per hectare tended to be obtained at the dose treatment of Natural Super Phospat fertilizer 100 kg P205/ha (P3) although statistically it was not significantly different from the

dose treatment of Natural Super Phospat fertilizer 50 kg P205/ha (Pl) and 75 kg P205/'ha (P2).

Effect of Potash Fertilizer Dosage

The results of the F test on variety analysis showed that the dose of potash fertilizer had no real effect on plant height aged 15, 30 and 45 HST, number of golden pods per clump, number of hollow pods per clump, dry pod weight per clump, weight of 100 dry seeds, dry seed weight per net plot and dry seed weight per hectare.

The average value of growth modifiers and bacilli of peanut plants observed due to potassium fertilizer dose treatment can be seen in Table 3. Table 3. Average plant height aged 15, 30 and 45 HST, number of golden pods per clump, number of hollow pods per clump, dry pod weight per clump, weight of 100 dry seeds, dry seed weight per net plot and dry seed weight per hectare due to potassium fertilizer dose treatment showed that the highest crop age of 15 HST tended, obtained at potassium fertilizer dose treatment of 50 kg K20/ha (Kl) although statistically different was not real with fertilizer dose treatment kaliurn 75 kg K20/ha (K2) and 100 kg K20/ha (K3), while at the age of 30 and 45 HST the highest plants tend to be obtained at the dose treatment of potassium fertilizer 100 kg K20/ha (K3) although statistically not significantly different from the dose treatment of potassium fertilizer 50 kg K20/ha (Kl) and 75 kg !<20/ha (K2).

The highest number of golden pods per clump tended to be obtained at the 100 kg K20/ha (K3) potassium fertilizer dose treatment, although statistically it was not real from the 50 kg K20/ha (Kl) and 15 kg K20/ha (K2) potassium fertilizer dose treatment, while the highest number of hollow pods per clump tended to be obtained at the 50 kg K.20/ha (Kl) potassium fertilizer dose treatment, although statistically it was not real from the 75 kg K. 20/ha (K2) and 100 kg K.20/ha (K3).

The highest dry pod weight per clump tends to be obtained at the dose treatment of potassium fertilizer I 00 kg K.20/ha (K3) although statistically it differs not significantly from the dose treatment of potassium fertilizer 50 kg K.20/ha (Kl) and 75 kg K20/ha (K2). The weight I 00 dry seeds, dry seed weight per net plot and dry seed weight per hectare tended to be obtained at potassium fertilizer dose treatment of 75 kg K20/ha (K2) although statistically not significantly different from potassium fertilizer dose treatment of 50 kg K.20/ha (Kl) and 100 kg K20/ha (K3).

Interaction

The results of the F test on variety analysis, showed that there was no real interaction between the dose factor of Natural Super Phospat fertilizer and the dose of potassium fertilizer against all growth modifiers and bacilli of peanut plants observed.

Effect of Natural Super Phospate Fertilizer Dosage

The results showed that the dose of Natural Super Phospat fertilizer had a significant effect on the weight of 100 dry seeds, but had no real effect on plant height aged 15, 30 and 45 HST, the number of golden pods per clump, the number of hollow pods per clump, the weight of dry pods per clump, the weight of dry seeds per net plot and the weight of dry seeds per hectare.

From various doses of Natural Super Phospat fertilizer studied in general, the highest growth and bacilli of peanut plants were obtained at the dose treatment of Natural Super Phospat fertilizer 100 kg P205/ha (P3) although it was not real from the treatment of P, and P2. This is because in the treatment dose of Super Phospat Natural fertilizer 100 kg P205/ha plants get Super Natural Phospat more than the dose treatment of Super Phospat Natural fertilizer 50 kg P205/ha (Pl) and 75 P205/ha (P2), so as to stimulate root growth and improve plant physiological processes in increasing nutrient absorption. Conversely, in the treatment dose of Natural Super Phospat fertilizer 50 kg P205/ha (Pl) and 75 kg P205/ha, (P2) plants obtained less Natural Super Phospat compared to the treatment of 100 kg P205/ha (P3) so that it allows plants to still lack Super Phospa nature.

According to Samosir et al. (2019) the provision of Fe and Mo micronutrients at the level of 1.0 g / plot can significantly increase the growth and yield of peanut plants. Hutubessy (2020) planting distance treatment of 20 x 30 cm and peanut variety Tala 2 gives the best results for peanut growth and production (Arachis hypogaea L).

Agussalim et al. (2003), stated that fertilizing plants that are not in accordance with their needs and nutrient adequacy levels will result in disruption to plants (Gandut et al., 2023). Each nutrient has a certain role in plant growth and development, especially macronutrients such as nitrogen (N), phosphorus (P) and potassium (K).

Effect of Potash Fertilizer Dosage

The results showed that the dose of potash fertilizer had no real effect on plant height aged 15, 30 and 45 HST, number of golden pods per clump, number of hollow pods per clump, dry pod weight per clump, weight of 100 dry seeds, dry seed weight per net plot and dry seed weight per hectare.

From several potassium fertilizer dose treatments that were tried, in general, the growth and has ii of the highest peanut plants each tended to be obtained at the dose treatment of potassium fertilizer I 00 kg K20/ha

(K3) and 75 kg K20/ha (K2), both treatments were statistically also not significantly different from 50 kg K20/ha. This is because at this dose the potassium needs for plants are not sufficient or still lacking. Symptoms of potassium deficiency are in plants where the leaves turn yellow, there are dead tissue stains in the middle or along the edges of the leaf blade, so that the leaves break easily. If the dose is increased by more than 100 kg K20/ha the probability of growth and yield will increase markedly.

According to Suprapto (2002), potassium deficiency in plants results in inhibition of the photosynthesis process. Symptoms that appear in potassium dcphycyte are leaves turn yellow, there are dead tissue stains in the middle of the sheet or along the edge of the leaf, growth is inhibited, the stem is less strong so it breaks easily, but economically the dose treatment of potassium fertilizer kg K20/ha is more beneficial than the dose treatment of potassium fertilizer 75 kg K20/ha and 100 kg K 20/ha.

Interaction

The results showed that there was no real interaction between the dose factor of Natural Super Phospat fertilizer and the dose factor of potassium fertilizer on all growth modifiers and yields of peanut plants observed. This means that the difference in the response of peanut plants due to differences in the dose of Natural Super Phospat fertilizer does not depend on the dose of potassium fertilizer, and vice versa.

Conclusion

The dose of Natural Super Phospat fertilizer had a significant effect on the weight of 100 dry seeds but had no real effect on the height of plants aged 15, 30 and 45 HST, the number of pithy pods per clump, the number of hollow pods per clump, the weight of dry pods per clump, the weight of dry seeds per net plot and the weight of dry beans per hectare. The highest growth and yield of dry seeds of peanut plants tend to be obtained at the dose treatment of Natural Super Phospat fertilizer 100 kg P205/ha. The dose of potash fertilizer was not apparent against plant height aged 15, 30 and 45 HST, number of long pods per clump, number of hollow pods per clump, weight of dry pods per clump, weight of l 00 dry seeds, weight of dry seeds per net plot and weight of dry seeds per hectare. Better growth and yield of dry seeds of peanut plants tend to be obtained at a dose of potash fertilizer 75 kg K.20/ha. There was no apparent interaction between the dosage factor of Natural Super Phospate fertilizer and the dose factor of potash fertilizer on all observed growth and yield modifiers of peanut plants.

Acknowledgments

The research team would like to thank the Universitas Gunung Leuser.

Author Contributions

For research articles with several authors, a short paragraph specifying their individual contributions must be provided. The following statements should be used "Conceptualization, Husainah. and Jailaini; methodology, Evi Apriana.; software, Elvitriana; validation, Ruhul Maghfirah and Husainah.; formal analysis, Ruhul Maghfirah; investigation, Elvitriana; resources, Jailani; data curation, Evi Apriana; writing—original draft preparation, Husainah; writing—review and editing, Ruhul Maghfirah; visualization, Jailani; supervision, Evi Apriana; project administration, Elvitriana; funding acquisition, Elvitriana. All authors have read and agreed to the published version of the manuscript." Please turn to the CRediT taxonomy for the term explanation. Authorship must be limited to those who have contributed substantially to the work reported.

Funding

This research received no external funding.

Conflicts of Interest

No Conflicts of interest.

References

Abidin, Z. (2022). *Paradigma Usaha Tani Tanaman Ternak Terintegrasi Optimal: Perspektif Sumber Daya Terbatas dan Musim Berbeda*. Penerbit Nem.

Alharby, H. F., Al-Zahrani, H. S., Hakeem, K. R., Alsamadany, H., Desoky, E.-S. M., & Rady, M. M. (2021). Silymarin-Enriched Biostimulant Foliar Application Minimizes the Toxicity of Cadmium in Maize by Suppressing Oxidative Stress and Elevating Antioxidant Gene Expression. *Biomolecules*, *11*(3), 465. https://doi.org/10.3390/biom11030465

Azzam, C. R., Al-taweel, S. K., Abdel-aziz, R. M., Rabea, K. M., Abou-sreea, A. I. B., Rady, M. M., & Ali, E. F. (2021). Salinity effects on gene expression, morphological, and physio-biochemical responses of stevia rebaudiana bertoni in vitro. *Plants*, *10*(4), 820. https://doi.org/10.3390/plants10040820

BPS. (2022). *Acces Time* (Vol. 09, Issue 31). Retrieved from https://sumbar.bps.go.id/indicator/53/60/1/luas-panen-produksi-dan-rata-rata-produksi-kacang-tanah-menurut-kabupaten-.html

Canavar, Ö. (2015). The influence of storage time on fatty acid, tocopherol and seed quality of peanut. *Quality Assurance and Safety of Crops & Foods*, *7*(2), 165–174. https://doi.org/10.3920/QAS2013.0276

Çiftçi, S., & Suna, G. Ü. L. E. N. (2022). Functional components of peanuts (Arachis Hypogaea L.) and health benefits: A review. *Future Foods*, *5*, 100140.

https://doi.org/10.1016/j.fufo.2022.100140

Desoky, E.-S. M., Mansour, E., Ali, M. M. A., Yasin, M. A. T., Abdul-Hamid, M. I. E., Rady, M. M., & Ali, E. F. (2021). Exogenously Used 24-Epibrassinolide Promotes Drought Tolerance in Maize Hybrids by Improving Plant and Water Productivity in an Arid Environment. *Plants*, *10*(2), 354. https://doi.org/10.3390/plants10020354

El-sherbeny, T. M. S., Mousa, A. M., & Zhran, M. A. (2023). Response of peanut (Arachis hypogaea L.) plant to bio-fertilizer and plant residues in sandy soil. *Environmental Geochemistry and Health*, *45*(2), 253–265. https://doi.org/10.1007/s10653-022-01302-z

ElSayed, A. I., Boulila, M., Rafudeen, M. S., Mohamed, A. H., Sengupta, S., Rady, M., & Omar, A. A. (2020). Melatonin Regulatory Mechanisms and Phylogenetic Analyses of Melatonin Biosynthesis Related Genes Extracted from Peanut under Salinity Stress. *Plants*, *9*(7), 854. https://doi.org/10.3390/plants9070854

Farasmayuda, Bahri, S., & Juanda, B. R. (2023). Upaya Peningkatan Pertumbuhan Dan Produksi Kacang Tanah (Arachis hypogaea L.) pada Beberapa Dosis Vermikompos dan Frekuensi Pembumbunan. *Jurnal Penelitian Agrosamudra*, *10*(2), 11–21. https://doi.org/10.33059/jupas.v10i2.8766

FDA. (2017). *FDA acknowledges qualified health claim linking early groundnut introduction and reduced risk of developing groundnut allergy*. Retrieved from https://www.fda.gov/food/cfsan-constituent-updates/fda-acknowledges-qualified-health-claim-linking-early-groundnut-introduction-and-reduced-risk.

Fujisao, K., Khanthavong, P., Oudthachit, S., Matsumoto, N., Homma, K., Asai, H., & Shiraiwa, T. (2020). Impacts of the continuous maize cultivation on soil properties in Sainyabuli province, Laos. *Scientific Reports*, *10*(1), 11231. https://doi.org/10.1038/s41598-020-67830-9

Gandut, Y. R. Y., Oematan, S. S., & Roefaidah, E. (2023). Pengaruh Perbedaan Konsentrasi Pupuk Organik Cair (Poc) Daun Kelor Terhadap Pertumbuhan Dan Hasil Tanaman Selada (Lactuca sativa L.). *Fruitset Sains: Jurnal Pertanian Agroteknologi*, *2*(11), 62. Retrieved from https://iocscience.org/ejournal/index.php/Fruitset/article/view/3809/2774

Guasch-Ferré, M., Liu, X., Malik, V. S., Sun, Q., Willett, W. C., Manson, J. E., Rexrode, K. M., Li, Y., Hu, F. B., & Bhupathiraju, S. N. (2017). Nut Consumption and Risk of Cardiovascular Disease. *Journal of the American College of Cardiology*, *70*(20), 2519–2532. https://doi.org/10.1016/j.jacc.2017.09.035

Gundaraniya, S. A., Ambalam, P. S., & Tomar, R. S. (2020). Metabolomic Profiling of Drought-Tolerant and Susceptible Peanut (Arachis hypogaea L.) Genotypes in Response to Drought Stress. *ACS Omega*, *5*(48), 31209–31219. https://doi.org/10.1021/acsomega.0c04601

Hutubessy, J. I. B. (2020). Pengaruh Jarak Tanam Terhadap Pertumbuhan Dan Hasil Tanaman Kacang Tanah (Arachis hipogaea L.). *Agrica*, *5*(1), 12–21. https://doi.org/10.37478/agr.v5i1.442

Jha, B., Mishra, A., & Chaturvedi, A. (2016). *Engineering stress tolerance in peanut (Arachis hypogaea L.). In Genetically Modified Organisms (GMO) Foods: Production, Regulation and Public Health*. Academic Press, Elsevier.

Mateva, K. I., Tan, X. L., Halimi, R. A., Chai, H. H., Makonya, G. M., Gao, X., & Massawe, F. (2023). Bambara groundnut (Vigna subterranea (L.) Verdc. In *Neglected and Underutilized Crops* (pp. 557–615). Academic Press.

Mekdad, A. A. A., El-Enin, M. M. A., Rady, M. M., Hassan, F. A. S., Ali, E. F., & Shaaban, A. (2021). Impact of Level of Nitrogen Fertilization and Critical Period for Weed Control in Peanut (Arachis hypogaea L.). *Agronomy*, *11*(5), 909. https://doi.org/10.3390/agronomy11050909

Mekdad, A. A. A., & Rady, M. M. (2016). Response of Beta vulgaris L. to nitrogen and micronutrients in dry environment. *Plant, Soil and Environment*, *62*(1), 23–29. https://doi.org/10.17221/631/2015-PSE

Mekdad, A. A. A., Rady, M. M., Ali, E. F., & Hassan, F. A. S. (2021). Early Sowing Combined with Adequate Potassium and Sulfur Fertilization: Promoting Beta vulgaris (L.) Yield, Yield Quality, and K- and S-Use Efficiency in a Dry Saline Environment. *Agronomy*, *11*(4), 806. https://doi.org/10.3390/agronomy11040806

Ojiewo, C. O., Janila, P., Bhatnagar-Mathur, P., Pandey, M. K., Desmae, H., Okori, P., Mwololo, J., Ajeigbe, H., Njuguna-Mungai, E., Muricho, G., Akpo, E., Gichohi-Wainaina, W. N., Variath, M. T., Radhakrishnan, T., Dobariya, K. L., Bera, S. K., Rathnakumar, A. L., Manivannan, N., Vasanthi, R. P., … Varshney, R. K. (2020). Advances in Crop Improvement and Delivery Research for Nutritional Quality and Health Benefits of Groundnut (Arachis hypogaea L.). *Frontiers in Plant Science*, *11*, 29. https://doi.org/10.3389/fpls.2020.00029

Pujiastuti, E. S., Siahaan, F. R., Tampubolon, Y. R., Tarigan, J. R., & Sumihar, S. T. T. (2021). Response of Soil and Peanut (Arachis hypogaea L.) on the Application of Several Local Microorganism and Manures. *Agrinula : Jurnal Agroteknologi Dan*

Perkebunan, *4*(1), 1–12. https://doi.org/10.36490/agri.v4i1.107

Rady, M. M., Boriek, S. H. K., Abd El-Mageed, T. A., Seif El-Yazal, M. A., Ali, E. F., Hassan, F. A. S., & Abdelkhalik, A. (2021). Exogenous Gibberellic Acid or Dilute Bee Honey Boosts Drought Stress Tolerance in Vicia faba by Rebalancing Osmoprotectants, Antioxidants, Nutrients, and Phytohormones. *Plants*, *10*(4), 748. https://doi.org/10.3390/plants10040748

Rady, M. M., Kuşvuran, A., Alharby, H. F., Alzahrani, Y., & Kuşvuran, S. (2019). Pretreatment with Proline or an Organic Bio-stimulant Induces Salt Tolerance in Wheat Plants by Improving Antioxidant Redox State and Enzymatic Activities and Reducing the Oxidative Stress. *Journal of Plant Growth Regulation*, *38*(2), 449–462. https://doi.org/10.1007/s00344-018-9860-5

Rehman, H. ur, Alharby, H. F., Bamagoos, A. A., Abdelhamid, M. T., & Rady, M. M. (2021). Sequenced application of glutathione as an antioxidant with an organic biostimulant improves physiological and metabolic adaptation to salinity in wheat. *Plant Physiology and Biochemistry*, *158*, 43–52. https://doi.org/10.1016/j.plaphy.2020.11.041

Samosir, O. M., Marpaung, R. G., & Laia, T. (2019). Respon kacang tanah (Arachis hypogaea L) terhadap pemberian unsur mikro. *Jurnal Agrotekda*, *3*(2), 74–83. Retrieved from https://jurnal.darmaagung.ac.id/index.php/agrotekda/article/view/725

Seleiman, M. F., Semida, W. M., Rady, M. M., Mohamed, G. F., Hemida, K. A., Alhammad, B. A., Hassan, M. M., & Shami, A. (2020). Sequential Application of Antioxidants Rectifies Ion Imbalance and Strengthens Antioxidant Systems in Salt-Stressed Cucumber. *Plants*, *9*(12), 1783. https://doi.org/10.3390/plants9121783

Taha, R., Seleiman, M. F., Alotaibi, M., Alhammad, B. A., Rady, M. M., & H. A. Mahdi, A. (2020). Exogenous Potassium Treatments Elevate Salt Tolerance and Performances of Glycine max L. by Boosting Antioxidant Defense System under Actual Saline Field Conditions. *Agronomy*, *10*(11), 1741. https://doi.org/10.3390/agronomy10111741

Taufiq, A., & Afandi, K. (2015). *Keharaan Tanaman Kacang Tanah* (Vol. 1, Issue 3). Malang: Balai Penelitian Kacang dan Umbi. Retrieved from https://repository.pertanian.go.id/server/api/core/bitstreams/888663a4-33ba-45c9-b4b1-96478af14507/content

Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., Garnett, T., Tilman, D., DeClerck, F., Wood, A., Jonell, M., Clark, M., Gordon, L. J., Fanzo, J., Hawkes, C., Zurayk, R., Rivera, J. A., De Vries, W., Majele Sibanda, L., … Murray, C. J. L. (2019). Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet*, *393*(10170), 447–492. https://doi.org/10.1016/S0140-6736(18)31788-4