



ASSESSMENT OF CORRELATION OF SOME AGRONOMIC TRAITS OF COWPEA (*Vigna unguiculata* (L.) Walp.) UNDER A WET SAVANNAH AGRO-ECOLOGY IN NIGERIA.

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ABSTRACT: The field trial was conducted across two locations to examine the correlations among three cowpea varieties (IT-04K-321-2 1460, Ex Borno, and Ife Brown) as well as several key morphological traits, including days to 50% flowering, leaf area, branching, nodulation, and grain yield. The primary objective of this study was to offer valuable guidance for selecting the most appropriate variety for intercropping systems in the wet savanna zone of Nigeria. Employing the Pearson correlation coefficient (r) at a p -value of 0.0000, the relationships between the traits were assessed. A notable correlation of 0.7430 was observed between days to 50% flowering and branching, indicating a moderately strong and highly significant positive linear relationship. Conversely, the correlation coefficient of -0.1397 between grain yield and branching suggests a very weak and statistically insignificant relationship, implying that branching may not play a significant role in enhancing yield. Encouragingly, we found a robust Pearson correlation coefficient (r) of 0.6700 between nodulation and flowering, signifying a strong and statistically significant positive linear relationship. Additionally, the correlation coefficient (r) of 0.5385 indicates a fairly strong positive association between variety and grain yield in cowpea. These findings suggest that grain yield is a complex, heritable trait significantly influenced by positive interactions among vegetative growth traits (including leaf area and branching), physiological traits (such as nodulation), and reproductive development traits (like flowering). To optimize yields, we recommend the implementation of agronomic practices that promote the effective expression of these traits. This approach will aid in selecting cowpea varieties that are well-suited for new farming systems and ecological contexts, ultimately contributing to enhanced productivity and sustainability in agricultural practices.

Keywords: Agronomic traits, adaptability, cowpea variety, farming system. Correlation.

INTRODUCTION

The relevance of cowpea in human nutrition cannot be overemphasized (Moroşan, *et al.* 2023; Shevkan *et al.* 2023). The crop has numerous varieties with adaptations to a wide range of ecologies across Nigeria. Based on this, cowpea is considered a reliable crop that has the potential to cope with the challenges of climate change (Otwe, 2024) and

various issues relating to food **security** (Da Silva *et al.* 2018; Hevkani *et al.* (2025) ; Muñoz-Amatriáin, *et al.* 2017). The successful adaptation of the crop is further supported by its ability to biologically fix the required nitrogen for its nutritional requirements (Masete *et al.* 2022; Mogale *et al.* 2023).

Records on cowpea production zones in Nigeria indicate that production activities are concentrated in the northern parts of the country, specifically the Sudan and Sahel savannas (Horn *et al.* (2022), Kouakou *et al.*, (2022); Ahungwa *et al.* (2020). Efforts are still

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ongoing to determine the adaptability of more cowpea varieties to certain ecological zones where the crop is presently considered a minor crop with characteristic low yield. Ewansiha and Osaigbovo, (2016); Ogunwande (2024); Amujoyegbe and Alabi (2013) reported that the intercropping farming system in Northern Nigeria is major factor that enhances cowpea productivity in the zone, while Ibeawuchi. (2007) reported that the major constraints that restrain cowpea production from being extensively cultivated in Southern Nigeria are the climate and the monoculture nature of the farming system.

In an attempt to boost cowpea production in Southern Nigeria, the use of seed technology, being a major factor in crop introduction into new environments, has crop fitness as a key objective. The adaptability of the seed to be introduced should thus be given foremost consideration (Omoigui *et al.*, 2023). Research efforts should also consider the compatibility of the crop as a component of the mixed intercropping farming system.

Based on the foregoing, the present study was structured to test the suitability of some cowpea varieties for adaptability to the wet savannah zone. According to Osunde *et al.* (2025), there is limited information on the genetic variability and *relationship between* traits and yield components of many varieties of *cowpea*. Report by Khady (2024) also established that cowpea's morphological traits are directly correlated with its ability to adapt to diverse climates and specific farming systems. There is thus a need to investigate some specific morphological traits of cowpea and their relationships with each other. This will facilitate and provide information on (i) the relationship between the morphological traits of cowpea, (ii) the relationship between genetic variability among traits and yield components of some varieties of cowpea, and

(iii) the contributions of each morphological trait to the entire cowpea growth and development for enhanced incorporation into the new farming system. To achieve this, the sub-objective is also structured to determine the correlation/relationship between the morphological traits of cowpea under some cultural interventions in an intercropping farming system.

MATERIALS AND METHODS

Description of Experimental Location

The experiment was conducted at two locations within the wet savannah ecological zone of Nigeria. The first location was the teaching and research farm of the University of Ilorin and the second location was Offa. The two locations were within Kwara State.

The coordinates for Ilorin, Nigeria, are approximately 8.54° North (Latitude) and 4.54° East (Longitude). The location has a Tropical Savanna Climate, characterized by distinct wet and dry seasons with high temperatures year-round. The climate features a hot, rainy period from February/March to October/November (peaking in September) and a dry, cooler season from November to February, with March being the hottest month before the rains arrives. The location is mildly hot year-round, with temperatures ranging from 33°C to 37°C. The average rainfall value is between 990mm to 1318mm annually, concentrated in the rainy season (March-Nov). The rainfall peak is recorded in September. The dry season spans within Nov - Mar with less rainfall leading into the hottest period (NiMET 2021). The soils in the Ilorin area of Kwara State, according to Olaniyan (2013) are generally sandy to loamy in texture, moderately acidic to neutral in pH, and characterized by low natural fertility. They are predominantly classified as Alfisols.

The second location, Offa, also in Kwara state of Nigeria, has general coordinates of 8°9'N, 4°43'E (or 8°15'N, 4°43'E). The location experiences a Tropical Wet and Dry (Savanna) climate, marked by distinct wet and dry seasons, high temperatures year-round, and seasonal rainfall. The rainy/wet season starts from May-October, and a dry season begins at

(November-April). The climate is consistently warm to hot, with average daily highs often in the range of 30s°C and cooler nights, especially during the dry season.

Rainfall is concentrated in the wet season. Sunlight varies seasonally, with clearer skies and more sun in the dry season. The general soil characteristics for Offa, Kwara State, according to Ige *et al.* (2020) are primarily sandy loam to loamy texture and are generally classified as Alfisols/Typic Plinthustalfs). The soils are typically deep but have inherently low fertility.

Land Preparation and Cultural Practices

The fields, which were basically occupied by leftover remnants of previously harvested crops, were manually cleared. One ploughing operation was done, followed by harrowing, which was done twice. The field was then demarcated into replications, main plots, and subplots.

Seed Sowing and Spacing: Maize was sown on September 3rd, 2024, at a spacing of 75cm by 1 m apart.

Plant population = Total plot size/area per plant = $36 \text{ m}^2 / 0.75 \text{ m}^2 = 48$ plants per plot

Cowpea was sown on October 30, 2024, at three different spacings shown below:

- i). Sole cowpea at a spacing of 25 cm × 50 cm; this gives 48 plants per plot, equivalent to 80,000 plants per hectare
- ii) 1:2 for 25 cm × 75 cm; this is equivalent to 32 plants per plot and 53,333 plants per hectare.
- iii) 2:4 for 50 cm × 75 cm; this is equivalent to 96 plants per plot and 26,666 plants per hectare

Manual weeding was done twice at 2 weeks after sowing cowpea and five weeks after sowing cowpea. Pest control: Organic pest control was achieved by spraying tobacco leaf extract (*Nicotiana tabacum*) following the methodology of Osang and Agba (2023), the application was conducted at the flower initiation stage, pod initiation stage, and full pod filling stage.

Experimental Design and Treatments

The experimental crops were i. Maize (variety) ii. Cowpea Variety - (a) IT-04K-321-2 1460 (b) Ex Borno (c) Ife Brown. The experiment was designed in a 3 × 3 factorial with Factor 1. Cowpea Varieties (i)

IT-04K-321-2 1460 (ii) Ex Borno (iii) Ife Brown; Factor 2. Nutrients (i). Compost (ii). P₂O₅ (iii). Compost + P₂O₅ and Factor 3. Inter-crop spatial arrangement (i) 1:2 maize: cowpea (ii) 2:4 maize: cowpea (iii) sole cowpea.

Data were collected on days to 50% flowering by sampling thirty plants that were tagged per plot. This was achieved by making daily observations to determine how long it took to achieve flowering of 50% of the 30 plants (= 9 plants) on each plot. To estimate branching, a sample of 15 plants was selected for the enumeration of the number of branches developed per plant. The leaf area was determined according to the methodology described by He *et al.* (2020). To enumerate nodulation, root nodule enumeration was done during the active foliage growth stage (specifically immediately after 50% flower initiation, a period physiologically identified as peak nodule formation. A sample of fifteen plants were carefully uprooted by excavating the soil block around the roots (to an approximate depth of 15 cm). This is aided by using a shovel to prevent stripping nodules from lateral roots. The area was watered to saturation before uprooting to loosen soil to minimize root damage. The roots are washed in a sieve with clean water to remove adhered soil. The number of observed nodules was recorded.

Grain yield was determined by first of all avoiding "edge effects" where the plants at the discard row/ border rows have experienced treatment interference from neighboring plots), harvesting was done only from a defined net plot area by harvesting from fifteen plant samples. This typically involved the two middle rows of the six-row plot designated for harvest. The harvesting was done when the pods turned yellowish brown, which indicated a physiological maturity. All mature pods were picked from the net plot area. Processing and Measurement: The harvested pods were dried on a tarpaulin to guard against seed loss from shattering. The dried pods were manually threshed to separate grains from the stover. Winnowing was done to remove debris and weigh the clean grain using a digital scale to obtain grain yield per plot. The grains

were sun-dried for three days to target 12–14% residual moisture content. The harvested weight from the small experimental plot/sampled net plot was converted into a standard unit (typically kg/ha)

$$\text{Grain yield (Kg/ha)} = \text{grain yield per plot (kg)} / \text{net}$$

Data Analysis:

The combined data (for the two locations) were subjected to Pearson correlation (r) analysis at p < 0.0001 using the software Statistix 8 package.

Hypothesis Test for Correlation Coefficients was set as follows:

- Null hypothesis: There is no linear relationship between the two variables. $\rho = 0$.
- Alternative hypothesis: There is a linear relationship between the two variables. $\rho \neq 0$

RESULTS AND DISCUSSION

Flowering and branching in cowpea correlated significantly. A Pearson correlation coefficient (r) of 0.7430 at a p-value of 0.0000 between the two agronomic traits (Table 1) indicated a moderately strong and highly positive linear relationship. The p-value of 0.0000 (which is reported as p < 0.0001 in

statistical terms) indicates that this strong positive association is highly unlikely to have occurred by chance, and the evidence is also very strong to support the existence of this relationship in the population from which the sample was drawn, suggesting that the two variables are closely linked. The alternative hypothesis (that there is a linear association in the population) can thus be confidently accepted. The positive sign indicates that as one trait (days to 50% flowering) increases, the other (number of branches) tends to increase as well. This result agrees with Ikpeme *et al.* (2021); Lo *et al.* (2023), Omem *et al.* (2023) Lim *et al.* (2025). In this context, as reported by Gashaw *et al.* (2020) cowpea plants that exhibit more branching tend to also flower more (or flower earlier, depending on how "flowering" was measured, e.g., days to flowering or number of flowers). The strong correlation suggests an inherent, likely genetic association or a shared physiological pathway influencing both traits (flowers and branches). Studies by Yeshitila *et al.* (2023) suggest that genotypic correlations are higher than phenotypic correlations, pointing to a strong underlying genetic control.

Table 1: Pearson Correlation Coefficient (r)

	Bra	Flo	Gra	La	Nod
Flo	0.7430 p <0.0000				
Gra	0.1397 p <0.2135	-0.2496 p <0.0246			
La	0.3437 p <0.0017	0.4336 p <0.0001	0.5539 p < 0.0000		
Nod	0.5447 p <0.0000	0.6700 p <0.0000	0.7714 p <0.0000	0.7248 p <0.0000	
Var	0.2776 p <0.0121	0.6129 p < 0.0000	0.5385 p <0.0000	0.2739 p <0.0134	0.6177 p <0.0000

Cases Included 81 Missing Cases 0

Key Gra = Grain yield, Flo= Flower count, days to 50% flowering per plot, La = Leaf area, Nod= Nodule count, and Var = Cowpea variety.

The strong correlation, according to Sodini *et al.* (2012); Sanda *et al.* (2022); Olanrewaju *et al.* (2021) suggests an inherent possibility of genetic association or a shared physiological pathway influencing both traits. Faye *et al.* (2023). Therefore, the use of inappropriate spacing by farmers

in cowpea production is one of the major factors that reduces cowpea yield. Bawa and Habib (2025); da Costa *et al.* (2017); Nderi *et al.* (2018)

Grain yield and branching in cowpea are negatively correlated. The r value of -0.1397 between the two traits indicates a very weak and statistically

insignificant relationship. As branching increases, grain yield tends to slightly decrease, and vice versa. According to standard guidelines for interpreting correlation strength, a value this close to zero indicates a very weak relationship. Branching explains very little of the variation in grain yield. P-value = 0.2135: This is the most critical figure. The P-value is much higher than the commonly accepted significance level of 0.05 (or 5%). The P-value suggests that the observed correlation of -0.1397 is possibly due to random chance or sampling variability, rather than a true underlying biological relationship.

The implication is that there is no statistically significant relationship. This is because the P-value (0.2135) is greater than 0.05, The null hypothesis (that there is no linear association in the population) can thus be confidently rejected. Further implication is that the number of branches a cowpea plant has is not a useful forecaster for its grain yield based on this data. The result is consistent with Teryima and Simon (2025) : Aliyu *et al.* (2022); Kumar *et al.* (2016).

A well-branched cowpea variety may exhibit low grain yield when the plant's resources are disproportionately allocated to vegetative growth rather than reproductive functions, or due to various external stresses. Publications by Tchiagam *et al.* (2010); Ogundele *et al.* (2021); Mguela *et al.* (2025) identify the factors that contribute to this phenomenon: a well-branched variety provides the *potential* for high yield by offering more flowering points, but without optimal environmental conditions and proper agronomic management to support pod formation and seed fill, this potential is not realized (Odesina, *et al.*, 2025). A plant's development is governed by the source-sink relationship, where leaves (sources) produce carbohydrates through photosynthesis, and growing parts like roots, new shoots, and developing grains (sinks) use these carbohydrates, as reported by Oladejo *et al.* 2010; Rajendra *et al.* 2023 ;Odesina *et al.* (2025)

According to Ndiso *et al.* (2016) some other factors, like agronomic practices and prevailing biotic and

abiotic factors, prevail in deciding the relationship between the interaction of grain yield and branching. (In high plant densities or intercropping systems, excessive branching can cause mutual shading and overcrowding. This leads to competition for light, water, and nutrients, which can inhibit the development of pods on those very branches.

Grain yield and nodulation in cowpea recorded a positive linear correlation coefficient ($r = 0.7714$) . This translates to mean that higher levels of nodulation are associated with higher grain yields. A p-value of 0.0000 indicates that this relationship is statistically highly significant and is extremely unlikely to occur by chance. This result is consistent with Owusu *et al.* (2012)but inconsistent with Boampong *et al.* (2017).

The simultaneous increase in cowpea grain yield with increased nodulation, according to Becker *et al.* (2024) is possibly primarily driven by enhanced Biological Nitrogen Fixation). The enhanced autotrophic nitrogen nutrition possibly enabled greater vegetative growth, improved capturing of photosynthetically active radiation, and higher absorption of nutrients, especially phosphorus (Kyei-Boahen *et al.* 2017; Adusei *et al.* 2021) and accumulation of nutrients for grain filling, as reported by Danso *et al.* (2025);Oladejo (2025);Ayalew *et al.* (2024)

nodulation and flowering recorded a strong, statistically significant positive linear relationship of (r) of 0.6700 at a p-value of 0.0000. The positive sign means that as nodulation and flowering seemed to increase simultaneously (or vice versa). The p-value of 0.0000 (which is less than the standard significance level of 0.05 or 0.01) translates to a correlation that is highly unlikely to have occurred due to random chance. The null hypothesis (that there is no linear association in the population) can thus be confidently rejected. This strong, significant correlation suggests a close biological or genetic link between the processes of nodulation and flowering in cowpea. This finding is consistent with earlier works of Abha and Meena (2024) ; Walle *et al.* (2018).

Enhanced nodulation, according to Becker *et al.* (2024) is often associated with better nitrogen fixation and the subsequent improved plant growth and grain yield. The positive association between flowering and nodulation thus suggests that genotypes with good nodulation potential also tend to flower well. This, in turn, contributes to overall crop performance and potentially higher yields. The strong correlation further supports the suggestion that the association with possibly linked genes may influence both traits. Another explanation by Yun *et al.* (2023); Yokota and Hayashi (2011) detailed that nodulation favored flowering in relation with Mobile microRNA signal (miR172c) produced in the root nodules. This miR172c acts as a long-distance mobile signal, translocating from the roots to the leaves. The increase in the level of hormones in the leaves facilitates enhanced flowering by suppressing a flowering repressor gene (GmTOE4a) that would have retarded the process.

Nodulation was also reported to be capable of facilitating enhanced access to an organic/ reduced form of biologically fixed nitrogen from the atmosphere. The fixed nitrogen, according to Ohyama 2014; Haskett (2025) is readily available for plant metabolism. This is crucial for overall growth and development (including flowering). According to Voisin *et al.* (2010) a biologically fixed nitrogen affords sufficient nitrogen nutrition that influences the cowpeas' overall health and guarantees the required resources for the transition to the energy-intensive reproductive phase (flowering and seed production) sooner than nitrogen-deficient plants.

nodulation and leaf area in cowpea recorded a strong, positive, and statistically significant relationship with a Pearson correlation coefficient (r) of 0.7248 (Table 1). The positive polarity implies that nodulation increases simultaneously with leaf area, and vice versa. In practical terms, this suggests that cowpea plants with more extensive or efficient nodulation generally develop larger leaf areas. A statistical significance ($p < 0.00001$, effectively 0.0000): indicates an extremely low p -value (less than a typical recommended significance level of 0.05), meaning the observed relationship is highly unlikely to be due to random chance. It can

confidently be concluded that a real, non-zero correlation exists in the population of cowpea plants from which the data were sampled. This result is consistent with Srinivas *et al.* (2017); Digrado *et al.* (2022); Mohammad and Rashid (2023); Vennila (2024)

The strong positive correlation, according to (Becker *et al.* (2024) ; Ayalew *et al.* (2022) has much more practical implications for cowpea productivity. This includes enhanced nitrogen fixation, a mechanism that provides ammonium ions (NH_4^+) and nitrate (NO_3^-) for plants' immediate absorption. The enhanced nitrogen nutrition, according to the explanations by Osunde *et al.* (2025) ; Oladejo *et al.* (2025) promotes overall cowpea growth, specifically the development of a larger leaf area. A larger leaf area facilitates an efficient capture of photosynthetically active radiation/solar income. The consequence of this correlation suggests that efficient nitrogen fixation (nodulation) directly supports the photosynthetic capacity, which enhances the plant's ability to accumulate higher dry matter.

Nodulation and branching recorded a statistically significant correlation coefficient of (0.5447) positive linear relationship (Table 1). This implies a moderate positive linear relationship. This indicates that as nodulation increases, branching also tends to increase, and vice versa. The two traits generally move in the same direction. Based on the general guidelines for interpreting correlation coefficients, this means the relationship is noticeable and biologically meaningful, but not perfect. There is still a good amount of variability in one trait that cannot be explained by the other alone. This means that cowpea plants that have more nodules tend to have more branches, and those with fewer nodules tend to have fewer branches. The variables generally increase or decrease together in a consistent, but not perfect, linear fashion.

A p -value of 0.0000 (which is typically reported when the p -value is extremely small, e.g., $p < 0.0001$) is well below the conventional significance level of 0.05. This low p -value means there is a strong evidence to reject the null hypothesis, which states that there is no linear relationship between the two

variables (i.e., The true correlation coefficient is zero). This further translates to mean that the result is not due to random chance. It is therefore reliable to generalize that a real association between nodulation and branching exists in the population from which the cowpea samples were drawn.

The implication of these results is that the processes of nodule formation and branching are moderately linked biological processes. This moderate positive correlation suggests that the two traits may be influenced by similar genetic or environmental factors (including spacing). This suggests that the genetic or physiological mechanisms that influence one trait may also influence the other. The significant correlation suggests a possibility that physiological or genetic link between branching and nodulation). This, according to Kgasudi *et al.* (2024) could mean that factors (genetic or environmental) that promote nodulation may also promote branching, or one trait may directly influence the other's development. Srinivas *et al.* (2017); Abha and Meena (2024)

In the context of cowpea physiology, the findings imply, formation of root nodules for nitrogen fixation and branching are physiologically related. According to Tesfaye, and Nebiyu (2021); Schober *et al.* (2018). the correlation might reflect the plant's overall vigor or its efficiency in resource use (e.g., nitrogen, carbon) acquisition and allocation, where a more vigorous plant can support both more extensive root nodulation and greater shoot branching. The variety and grain yield of cowpea recorded a moderate, positive, and highly statistically significant linear relationship with Pearson correlation coefficient (r) of 0.5385. The positive polarity indicated that there is a direct relationship between the specific genetic characteristics (variety) and the resulting grain yield. This translates to mean that cowpea variety may be linked changes to changes that increase in yield. The p -value of 0.0000 (which is less than the standard significance level of 0.05 or 0.01) indicates that the observed correlation is highly unlikely to be due to random chance. This demonstrates that the population from which the data was sampled has a true, reliable relationship. This further confirms that

a real, dependable relationship exists in the population from which the data was sampled. The result is consistent with Almeida *et al.* (2014); Aliyu *et al.* (2022); Matjeke *et al.* (2025).

The moderate correlation, according to Sultan *et al.* (2021) ; Adusei *et al.* (2021) suggests that the variety of cowpea is a useful, but not perfect, predictor of its grain yield. This finding is relevant because it indicates that direct selection for certain desirable varietal traits would be effective in improving grain yield. The traits contributing to the correlation are thus important for crop improvement.

Cowpea variety and nodulation recorded a strong positive association with a correlation coefficient value of 0.6177 (Table 1). The result indicated that as the specific genetic traits associated with varieties are altered, nodulation tends to increase. An explanation from plant-microbe interactions and genetics indicated a correlation of notable magnitude and suggests a meaningful biological relationship. The implication of the p -value of 0.0000 (which is typically less than the conventional significance level of 0.05 (or 0.01), indicates that the observed correlation is highly unlikely to have occurred by random chance. The null hypothesis (which states there is no linear relationship between the variables) can confidently be rejected. This implies a significant relationship exists between cowpea variety and nodulation. The results suggest that cowpea variety is a strong and highly significant predictor of nodulation levels. This is consistent with Ruchika and Meena (2024);Turney (2024);Schober *et al.* (2018). This finding is highly reliable from a statistical stand point and has practical implications for agricultural research, such as selecting specific cowpea varieties for breeding programs aimed at exploring nitrogen fixation, as reported by Partii *et al.* (2024),

The biological and functional implication of the established strong and significantly positive correlation implies that certain cowpea varieties have a superior ability or tendency to form root nodules compared with others. Since nodulation is a crucial nutrient required for plants to fix atmospheric nitrogen, this finding, according to Oladejo *et al.*

2025; Jogdhande *et al.* 2017; Putri and Nugrahaeni (2021) has significant practical implications in crop husbandry. The use of high-nodulating varieties, in combination with effective *Bradyrhizobium* strains, can effectively enhance the plant's nitrogen fixation, leading to better growth, higher grain yield, and improved soil fertility.

Summary

Pearson correlation analysis of cowpea varieties and some agronomic traits demonstrates that, within intercropping farming systems, agronomic traits such as leaf area, nodulation, branching, flowering, and grain yield are interdependent and form a complex biological network. Enhancements in one trait often reinforce or impede others. These findings indicate that cowpea yield is a multidimensional trait regulated by both vegetative vigor, reproductive efficiency, and the environment.

Conclusion

To select and introduce a well-adapted variety of cowpea into a new farming system or a new ecology, selection of varieties that exhibit appreciable

vegetative vigor (leaf area), and efficient root systems (nodulation) is paramount. Because traits like branching and nodulation are strongly correlated with yield, breeders and agronomists may use them as indirect selection or molecular markers (a traceable DNA sequence closely linked to a desirable gene) If it is difficult to measure yield directly (e.g., Early in the season), selecting for high nodulation, leaf area, early attainment of 50% flower population, or branch count can reliably point to higher-yielding varieties.

Recommendation

Based on the findings from the present study, it is recommended that while introducing a variety of cowpea into a farming system, issues to be considered are (i) varieties that combine high nodulating potential with robust vegetative (good flowering, branching, and leaf area) growth, (ii) agronomic practices such as seed inoculation (with rhizobium species), optimum/appropriate spacing should also be adopted.

REFERENCES

- Abha, R., and Meena, M. L. (2024). Correlation and path analysis in cowpea (*Vigna unguiculata* (L.) Walp.). *Journal of Experimental Agriculture International*, 46(7):1071-1085.
doi.org/10.9734/jeai/2024/v46i72660
- Abiodun, O., Adesike, K., and Christopher, I. (2020). Assessment of variation in the agronomic traits of wild cowpea (*Vigna unguiculata* (L.) Walp.) subspecies under a rainforest agroecology in Nigeria. *GSC Biol. Pharm. Sci*, 11(3): 244-253.
- Adetayo, A. O., Balogun, A., and Balogun, I. (2023). Understanding options for improving cowpea production under changing climatic and variability in rain-forest agro-ecology of Nigeria. *Discovery* 2023; 59:e111d1351
doi.org/10.54905/disssi.v59i333.e111d1351
- Adusei, G., Aidoo, M. K., Srivastava, A. K., Asibuo, J. Y., and Gaiser, T. (2021). The variability of grain yield of some cowpea genotypes in response to phosphorus and water stress under field conditions. *Agronomy*, 11(1):28.
<https://doi.org/10.3390/agronomy11010028>
- Ahungwa, G. T., Mukhtar, U., and Muhammad, K. M. (2020). Trends analysis of cowpea area and productivity in Nigeria from 2006-2018. *Journal of Agripreneurship and Sustainable Development*, 3(3): 172-180.
- Aliyu, O. M., Tiamiyu, A. O., Usman, M., and Abdulkareem, Y. F. (2022). Variance components, correlation and path analyses in cowpea (*Vigna unguiculata* L., Walp). *Journal of Crop Science and Biotechnology*, 25(2):173-182.
- Almeida, W. S. D., Fernandes, F. R. B., Teófilo, E. M., and Bertini, C. H. C. D. M. (2014). Correlation and path analysis in components of grain yield of cowpea genotypes. *Revista Ciênciá Agrônômica*, 45:726-736.
- Amujoyegbe B. J., and Alabi O. S. (2013) Cropping system analysis of two agro ecological zones of Southwestern Nigeria. *African Journal of Agricultural Economics and Rural Development* (1)1:23 27.
- Ayalew T, Yoseph T, Högy P, Cadisch G. (2022) Leaf growth, gas exchange and assimilation performance of cowpea varieties in response to *Bradyrhizobium* inoculation. Heliyon.

- 8(1):e08746. doi: 10.1016/j.heliyon.2022.e08746.
- Ayalew, T., Yoseph, T., and Cadisch, G. (2024). Symbiotic N₂ fixation in cowpea varieties is markedly enhanced by inoculation with elite *Bradyrhizobium* strains. *Rhizosphere*, 32:1-10:100976. <https://doi.org/10.1016/j.rhisph.2024.100976>
- Bawa, A., and Habib, S. (2025). Influence of spacing on growth and yield of cowpea (*Vigna unguiculata* (L.) Walp.) varieties under rainfed in the Guinea Savannah Zone of Ghana. *Advances in Agriculture*, 2025(1):8854224. doi.org/10.1155/aia/8854224
- Becker, J. N., Grozinger, J., Sarkar, A., Reinhold-Hurek, B., and Eschenbach, A. (2024). Effects of cowpea (*Vigna unguiculata*) inoculation on nodule development and rhizosphere carbon and nitrogen content under simulated drought. *Plant and Soil*, 500(1):33-51. doi.org/10.1007/s11104-023-06051-1
- Becker, J. N., Grozinger, J., Sarkar, A., Reinhold-Hurek, B., and Eschenbach, A. (2024). Effects of cowpea (*Vigna unguiculata*) inoculation on nodule development and rhizosphere carbon and nitrogen content under simulated drought. *Plant and Soil*, 500(1): 33-51. doi.org/10.1007/s11104-023-06051-1
- Becker, J. N., Grozinger, J., Sarkar, A., Reinhold-Hurek, B., and Eschenbach, A. (2024). Effects of cowpea (*Vigna unguiculata*) inoculation on nodule development and rhizosphere carbon and nitrogen content under simulated drought. *Plant Soil*, 500:33–51. <https://doi.org/10.1007/s11104-023-06051-1>
- Boampong E. Y. , E. A. Yakubu, K. Owusu-Osafo, A.A. Darkwa and W. H. K. Dorgbetor (2017). Effect of NPK (23-10-5) on Nodulation in Two Cowpea Varieties (Asontem and Asetenapa), *Journal of Biology, Agriculture and Healthcare*, 7(2): 50-57.
- da Costa, A. F., de Oliveira, A. B., do Vale, L. S., de Brito Neto, J. F., Magalhaes, I. D., and de Souza Ferraz, R. L. (2017). Morpho-agronomic characteristics of cowpea under different environments and planting densities. *African Journal of Agricultural Research*, 12(25):21252130. doi.org/10.5897/AJAR2017.12455
- Da Silva, A. C., da Costa Santos, D., Junior, D. L. T., da Silva, P. B., dos Santos, R. C., and Siviero, A. (2018). Cowpea: A strategic legume species for food security and health. In *Legume seed nutraceutical research*. IntechOpen. doi: 10.5772/intechopen.79006.
- Danso, J., Ulzen, J., Ahenkan, M., Ulzen, O. O., Asei, R., Sarkodie-Addo, J., and Appiah-Agyei, C. (2025). Growth and yield response of cowpea [*Vigna unguiculata* (L.) Walp.] to nitrogen fertilizer and inoculant application. *Agrosystems, Geosciences and Environment*, 8(4):1-17. e70237.
- Digrado, A., Gonzalez-Escobar, E., Owston, N., Page, R., Mohammed, S. B., Umar, M. L., and Carmo-Silva, E. (2022). Cowpea leaf width correlates with above ground biomass across diverse environments. *Legume Science*, 4(4):e144. <https://doi.org/10.1002/leg3.144>
- Ewansiha, S.U. and Osaigbovo, A.U. (2016) Cowpea for A Changing Environment in the rainforest of South-South Nigeria. *Agro-Science Journal of Tropical Agriculture, Food, Environment and Extension*.15 : 23-28
- Faye, A., Obour, A. K., Akpilo, T. M., Stewart, Z. P., Min, D., Prasad, P. V., and Assefa, Y. (2024). Dual-purpose cowpea grain and fodder yield response to variety, nitrogen–phosphorus–potassium fertilizer, and environment. *Agrosystems, Geosciences and Environment*, 7(1): e20459. <https://doi.org/10.1002/agg2.20459>
- Gashaw, Z., Gebreselassie, W., and Hailemichael, G. (2020). Correlation and Path Coefficient Analysis in Yield and Yield-Related Components of Black Cumin (*Nigella Sativa* L.) Accessions, at Jimma, Southwest Ethiopia. *International Journal of Agronomy*, 2020(1), 8837794
- Haskett, T. L., Cooke, L., Green, P., and Poole, P. S. (2025). Regulation of Rhizobial Nodulation Genes by Flavonoid-Independent Nodule Supports Nitrogen-Fixing Symbioses With Legumes. *Environmental Microbiology*, 27(1), e70014.
- He, J., Reddy, G. V., Liu, M., and Shi, P. (2020). A general formula for calculating surface area of

- the similarly shaped leaves: Evidence from six Magnoliaceae species. *Global Ecology and Conservation*, 23, e01129. <https://doi.org/10.1016/j.gecco.2020.e01129>.
- Hevkani, K., Shivani, B., Dhaka, S.S. *et al.* Cowpeas for sustainable agriculture and nutrition security: an overview of their nutritional quality and agro-economic advantages. *Discov Food* 5:109 (2025). <https://doi.org/10.1007/s44187-025-00382-x>
- Horn, L. , Nghituwamhata, S. and Isabella, U. (2022) : Cowpea production challenges and contribution to livelihood in Sub-Saharan Region. *Agricultural Sciences*, 13, 25-32. doi: [10.4236/as.2022.131003](https://doi.org/10.4236/as.2022.131003).
- Ibeawuchi, I. I. (2007). Intercropping-A food production strategy for the resource poor farmers. *Nature and Science*, 5(1):46-59.
- Ige, J. A., Ibitoye, B. A., Kazeem, M. B., and Federal, T. (2020). Geotechnical properties of Offa lateritic soils and its suitability as subbase and base materials. *International Journal of Civil and Structural Engineering Research*, 8(5): 645-652.
- Ikpeme, E. V., A. I. Nta , U. B. Ekaluo1 and O. Udensi (2012): Phytochemical screening and haematological evaluation of parkia biglobossa and gongronema latifolium J. Basic. Appl. Sci. Res., 2(3)2599-2606.
- Kgasudi, B. K., Ngwako, S., Malambane, G., Pholo_Tait, M., and Lekgari, L. A. (2024). Genetic variability, heritability, correlation and path coefficient analysis of growth and yield traits of cowpea [*Vigna unguiculata* (L.) Walp] parental genotypes and their F crosses. *European Journal of Agriculture and Food Sciences*, 6(5)17-28 doi.org/10.24018/ejfood.2024.6.5.821
- Khady, D., Nadiala, C. Y., Roger, D. B. I., Raymond, K. Y., Lassana, T., and Kevin, K. K. (2024). Morphological traits variation of cowpea (*Vigna unguiculata* L. Walp) grown in Côte d'Ivoire. 23(1):17-27, DOI: [10.5897/AJB2023.17623](https://doi.org/10.5897/AJB2023.17623)
- Kouakou, AG., Ogundapo, A., Smale, M. *et al.* IITA's genebank, cowpea diversity on farms, and farmers' welfare in Nigeria. *CABI Agric Biosci* 3, 14 (2022).doi.org/10.1186/s43170-022-00083-w
- Koura, A. A., Kena, A. W., Annor, B., Adejumobi, I. I., Maina, F., Sayadi Maazou, A. R., and Akromah, R. (2025). Multi-traits selection index for selection of cowpea (*Vigna unguiculata* (L.) Walp.) genotypes for resistance to *Striga gesneroides*. *Scholars Academic Journal of Biosciences*, 13(9): 1351-1362
- Kumar, N. M., Gangaprasad, S., Anjali, M., Sunil, M., and Nagaraja, L. (2016). Correlation and path analysis for yield and yield contributing traits in cowpea (*Vigna unguiculata* L. Walp.). *Research Journal of Agricultural Sciences*, 7(2), 454-457.
- Kyei-Boahen, S., Savala, C. E., Chikoye, D., and Abaidoo, R. (2017). Growth and yield responses of cowpea to inoculation and phosphorus fertilization in different environments. *Frontiers in plant science*, 8:1-17 DOI=[10.3389/fpls.2017.00646](https://doi.org/10.3389/fpls.2017.00646)
- Lim S, Baek I, Hong SM, Lee Y, Kirubakaran S, Kim MS, Meinhardt LW, Park S, Ahn E. Cacao floral traits are shaped by the interaction of flower position with genotype. *Heliyon*. 3;11(4):e42407. doi: [10.1016/j.heliyon.2025.e42407](https://doi.org/10.1016/j.heliyon.2025.e42407).
- Lo, S.-K., Hu, C.-Y., Roan, S.-F., Su, T.-C., and Chen, I.-Z. (2023). Relationship between flower phenotypic traits and fruit yields in Tea (*Camellia sinensis* L.) Varieties. *Horticulturae*, 9(4), 440. doi.org/10.3390/horticulturae9040440
- Masete, F.M.; Munjonji, L.; Ayisi, K.K.; Mopape-Mabapa, M.P. (2022,) Cowpea Growth and Nitrogen fixation performance under different mulch treatments. *Agriculture*, 12 :2-17, 1144.
- Matjeke, B. M., Labuschagne, M., Gerrano, A. S., Minnaar-Ontong, A., and Mbuma, N. W. (2025). Correlations between grain yield, its components and nutritional traits for cowpea (*Vigna unguiculata* L. Walp) f1 progenies and their parental genotypes. *South African Journal of Botany*, 187:268-275.7.
- Mgula, M. B., Lyimo, L. D., and Sanga, H. G. (2025). Performance of cowpea varieties under different phosphorus levels and spacing in Tanzania. *Cogent Food and Agriculture*, 11(1), 2595295. doi.org/10.1080/23311932.2025.2595295
- Mogale, E. T., Ayisi, K. K., Munjonji, L., and Kifle, Y. G. (2023). Biological Nitrogen Fixation of Cowpea in a No-Till Intercrop under Contrasting Rainfed Agro-Ecological Environments. *Sustainability*, 15(3): 2244. doi.org/10.3390/su15032244

- Mohammad, M. T., and Rashid, H. H. (2023). Correlation Coefficient and Path Analysis of yield and its components for seven cowpea genotypes (*Vigna unguiculata* L.) and its F1 hybrids. *Tikrit Journal for Agricultural Sciences*, 23(4), 1-12.
- Moroşan, E., Lupu, C. E., Mititelu, M., Musuc, A. M., Rusu, A. I., Răducan, I. D., Karampelas, O., Voinicu, I. B., Neacşu, S. M., Licu, M., Pogan, A. C., Cîrnaţu, D., Ilie, E. I., and Dărăban, A. M. (2023). Evaluation of the Nutritional Quality of Different Soybean and Pea Varieties: Their Use in Balanced Diets for Different Pathologies. *Applied Sciences*, 13(15):8724. <https://doi.org/10.3390/app13158724>
- Muñoz-Amatriaín, M., Mirebrahim, H., Xu, P., Wanamaker, S. I., Luo, M., Alhakami, H., and Close, T. J. (2017). Genome resources for climate-resilient cowpea, an essential crop for food security. *The Plant Journal*, 89(5):1042-1054.
- Muñoz-Amatriaín, M., Mirebrahim, H., Xu, P., Wanamaker, S. I., Luo, M., Alhakami, H., and Close, T. J. (2017). Genome resources for climate-resilient cowpea, an essential crop for food security. *The Plant Journal*, 89(5), 1042-1054.
- Nderi, L. M., Kamau, P., and Njoka, E. M. (2018). Effect of different spacing intervals on growth and yield of cowpea varieties in kilifi county, kenya. *International Journal For Research In Agricultural and Food Science*, 4(8), 1–25. <https://gnpublication.org/index.php/afs/article/view/720>
- Ndiso, J. B., Chemining'wa, G. N., Olubayo, F. M., and Saha, H. M. (2016). Effect of drought stress on canopy temperature, growth and yield performance of cowpea varieties. *International Journal of Plant and Soil Science*, 9(3), 1-12.
- NiMET (2024) *Nigerian Meteorological Agency*. <https://nimet.gov.ng/>
- Odesina, I. S., Utoblo, O. G., Oyeboode, G. O., Ongom, P. O., Boukar, O., and Namu, O. A. T. (2025). Growth and Yield Responses of Cowpea to Plant Densities in Two Agro-Ecologies in Northern Nigeria: A Yield Compensation Mechanism. *Agriculture*, 15(16): 1738. <https://doi.org/10.3390/agriculture15161738>
- Odesina, I. S., Utoblo, O. G., Oyeboode, G. O., Ongom, P. O., Boukar, O., and Namu, O. A. T. (2025). Growth and yield responses of cowpea to plant densities in two agro-ecologies in Northern Nigeria: a yield compensation mechanism. *Agriculture*, 15(16), 1738.. doi.org/10.3390/agriculture15161738
- Ogundele M.M., Olatunji folashade and Owoade F.M (2021) Response of Cowpea to sources and rate pf phosphorus in Ogbomosho GSJ: 9(10):1-53
- Ogunwande, I. O. (2024). Factors affecting the adoption of cropping system among arable crop farmers in southwest nigeria. *Nigerian Journal of Horticultural Science*, 28(1).
- Ohyama, T. (Ed.). (2014). Advances in Biology and Ecology of Nitrogen Fixation. InTech. doi: 10.5772/56990
- Oladejo, A. S., Akinwale, R. O., and Obisesan, I. O. (2011). Interrelationships between grain yield and other physiological traits of cowpea cultivars. *African Crop Science Journal*, 19(3): 189-200.
- Oladejo, A., Atere, C., Osunde, O., Sanwo, A., and Adegbaio, O. (2025). Nodulation efficiency and yield components in cowpea (*Vigna unguiculata* L. Walp.) varieties cultivated in southwestern Nigeria. *Ife Journal of Agriculture*, 37(1): 64-85.
- Olaniyan, J. O. (2013). Characterization, classification and agricultural potential of some selected soils of Kwara State, Nigeria. *Nigerian (Luvisols in the FAO system) J Soil Sci*, 23(1):94-101).
- Olanrewaju, O. S., Oyatomi, O., Babalola, O. O., and Abberton, M. (2021). Genetic diversity and environmental influence on growth and yield parameters of Bambara groundnut. *Frontiers in Plant Science*, 12, 796352. doi: 10.3389/fpls.2021.
- Omeme T., Balaji S K., Thupten T, Ampee, T and LJoymati, Chan (2023) Correlation and path coefficient analysis in gaillardia (*Gaillardia pulchella* Foug.) genotypes. *The Pharma Innovation Journal*, 12(6): 201-206
- Omoigui, L. O., Kamara, A. Y., Shaibu, A. S., Aliyu, K. T., Tofa, A. I., Solomon, R., and Olasan, O. J. (2023). Breeding Cowpea for Adaptation to Intercropping for Sustainable Intensification in the Guinea Savannas of

- Nigeria. *Agronomy*, 13(6),1451.<https://doi.org/10.3390/agronomy13061451>
- Omomowo, O. I., and Babalola, O. O. (2021). Constraints and prospects of improving cowpea productivity to ensure food, nutritional security and environmental sustainability. *Frontiers in Plant Science*, 12, 751731.. doi: 10.3389/fpls.2022.1042678.
- Osunde, Michael and Oladejo, and Atere, Cornelius and Sanwo, O and Adegbaaju, A. (2025). Nodulation efficiency and yield components in cowpea (*Vigna unguiculata* L. Walp.) varieties cultivated in South -Western Nigeria. 31:64-85.
- Otwe, E. P. (2024). Impacts of Climate Change on Cowpea and Soybean Production in Africa: Challenges and Adaptations. *Direct Research Journal of Agriculture and Food Science*, 12(3):131-142.
- Owusu, E. Y., Karikari, B., Kusi, F., Haruna, M., Amoah, R. A., Attamah, P., ... and Issahaku, M. (2021). Genetic variability, heritability and correlation analysis among maturity and yield traits in Cowpea (*Vigna unguiculata* (L) Walp) in Northern Ghana. *Heliyon*, 7(9). e07890
- Partii A.S., Bendale V.W., Bhawe, S.G and Mahta (2004). correlation and Part Analysis Study of Biomass Partitioning Character in Cowpea. The Orissa Journal of Horticulture. 32(1): 19-23
- Putri, P. H., and Nugrahaeni, N. (2021,). Cowpea [*Vigna unguiculata* (L.) Walp.] Yield Variance and Supported Character. In *3rd KOBIC Congress, International and National Conferences (KOBICINC 2020)* (pp. 65-71). Atlantis Press.
- Rajendra Darai, Padam Poudel, NH Ghimire and Man Bahadur Chadaro. (2023) Evaluation of yield and yield attributes of seed type cowpea genotypes (*Vigna unguiculata* (L.) Walp.) in Mid-Western terai of Nepal. *Ecol Conserv Sci*. 2(3): 555587 DOI:10.19080/ECO.A.2023.02.555587
- Ramesh, K G., Pramila, B. and Udit, K(2019) Study on Correlation and path analysis in cowpea (*Vigna unguiculata* (L.) Walp.). *International Journal of Chemical Studies*. 7(6):1264-1268
- Ruchika Abha, and M. L. Meena. 2024. "Correlation and Path Analysis in Cowpea (*Vigna unguiculata* (L.) Walp.)". *Journal of Experimental Agriculture International* 46 (7):1071–1085.
<https://doi.org/10.9734/jeai/2024/v46i72660>.
- Sanda, A. J., Bemji, M. N., Wheto, M., Oso, A. O., Sanda, M. O., and Olowofeso, O. (2022). Genetic and phenotypic correlation coefficients of quantitative traits in two chicken genotypes. *Genetika*, 54(1),307-328.
<https://doi.org/10.2298/GENSR2201307S>
- Schober, P., Boer, C., and Schwarte, L. A. (2018). Correlation Coefficients: Appropriate Use and Interpretation. *Anesthesia and analgesia*, 126(5): 1763–1768. <https://doi.org/10.1213>
- Shevkani, K., Shivani, B., Dhaka, S. S., and Patil, C. (2025). Cowpeas for sustainable agriculture and nutrition security: an overview of their nutritional quality and agro-economic advantages. *DiscoverFood*, 5(1):109.<https://doi.org/10.1007/s44187-025-00382-x>
- Sodini, S. M., Kemper, K. E., Wray, N. R., and Trzaskowski, M. (2018). Comparison of genotypic and phenotypic correlations: Cheverud's conjecture in humans *Genetics*, 209(3):941-948. doi:10.1534/genetics.
- Srinivas, J., Kale, V. S., Nagre, P. K., and Meshram, S. (2017). Correlation and path analysis study in cowpea [*Vigna unguiculata* (L.) Walp.] genotypes. *International Journal of Current Microbiology and Applied Sciences*, 6(6):3305-3313. doi.org/10.20546/ijcmas.2017.606.388
- Sultan, F. M., Mousa, W. M., and Ghareeb, Z. E. (2021). Relationship between yield and its components to detect the direct and indirect effects in some cowpea and guar genotypes.. *International Journal of Scientific and Research Publications (IJSRP)*. 1:297-307. 10.29322/IJSRP.11.01.2021.p10931.
- Tchiagam, J. B. N., Bell, J. M., Birwe, S. G., Gonne, S., and Youmbi, E. (2010). Varietal response of cowpea (*Vigna unguiculata* (L.) Walp.) to *Striga gesnerioides* (Willd.) Vatke race SG5infestation. *Notulae Botanicae Horti Agrobotanici Cluj-Napoca*, 38(2):33-41.
- Teryima I and Simon N M. ((2025) "Correlation Study of Cowpea Agronomic Traits with Grain Yield in The Guinea Savanna Agro-Ecological Zone of Nigeria". *Medicon Agriculture and Environmental Sciences* 8.6 : 52-61.
- Tesfaye, T., and Nebiyu, A. (2021). Evaluation of cowpea (*Vigna unguiculata* (L.) Walp) genotypes for nodulation performance and biological nitrogen fixation in the lowlands of Southern and

- Southwestern Ethiopia. *Journal of Agricultural and Veterinary Sciences*, 9(1), 22-31.
- Turney, S. (2024). *Pearson Correlation Coefficient (r) | Guide and Examples*. Scribbr. Retrieved October 21, 2025, from <https://www.scribbr.com/statistics/pearson-correlation-coefficient/> (Russell, K. N. (2025). *A Quantitative Analysis on Chronic Absenteeism and Its Effects on Students' Achievement* (Doctoral dissertation, South College)
- Vennila C. (2024). Assessment of Leaf Area Index and its Relationship with Growth and Yield of Fodder Cowpea as Influenced by Sources of Irrigation and Nutrients . *Legume Research*. 47(12): 2077-2085. doi: 10.18805/LR-5265.
- Voisin, A. S., Munier-Jolain, N. G., and Salon, C. (2010). The nodulation process is tightly adjusted to plant growth. An analysis using environmentally and genetically induced variation of nodule number and biomass in pea. *Plant and Soil*, 337(1): 399-412.
- Wafula, J. K., Njoka, F. M., Nthakanio, P. N., Mosioma, J. O., Mukono, S. T., and Onyari, C. A. (2021). Nodulation and protein content of selected chickpea varieties as impacted by spacing and n-fertiliser rates in Eastern Kenya. *African Journal of Agricultural Research*, 17(6), 882-895.. DOI: [10.5897/AJAR2021.15597](https://doi.org/10.5897/AJAR2021.15597)
- Walle, T. , Mekbib, F. , Amsalu, B. and Gedil, M. (2018) Correlation and Path Coefficient Analyses of Cowpea (*Vigna unguiculata* L.) Landraces in Ethiopia. *American Journal of Plant Sciences*, 9:2794-2812. doi: [10.4236/ajps.2018.913202](https://doi.org/10.4236/ajps.2018.913202).
- Yeshitila, M., Gedebo, A., Degu, H.D. *et al.* (2023) Study on characters associations and path coefficient analysis for quantitative traits of amaranth genotypes from Ethiopia. *Sci Rep* 13: 20981 (2023). <https://doi.org/10.1038/s41598-023-47869-0>
- Yokota K, Hayashi M. Function and evolution of nodulation genes in legumes. *Cell Mol Life Sci*. 2011Apr;68(8):1341-51. doi:10.1007/s00018-011-0651-4. Epub 2011 Mar 5. PMID: 21380559; PMCID: PMC11114672
- Yun, J., Wang, C., Zhang, F., Chen, L., Sun, Z., Cai, Y., and Li, X. (2023). A nitrogen fixing symbiosis-specific pathway required for legume flowering. *Science Advances*, 9(2):eade1150. *Sci Adv*. 2023 Jan 13;9(2):eade1150. doi: 10.1126/sciadv.ade1150

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