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Effects of Organic Manure: Amirthakaraisal and Cow Dung on Performances of Greengram (*Vigna radiata*) Grown in Pots

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Abstract* - Green gram (*Vigna radiata*) is an annual important pulse crop that mainly grown in tropical, subtropical and temperate regions of Asia. Traditionally it is grown on commercial scale with synthetic fertilizer and on subsistent scale with organic manure. Amirthakaraisal is an organic liquid nutrient solution containing of N, P and K. The present study was conducted with the objective of investigating the effect of combination of Amirthakaraisal and Cow dung on the growth and yield of *Vigna radiata*. The experiment was conducted as a pot experiment with six treatments and ten replicates in a completely randomised design (CRD). This was maintained in open field. The treatments are T1-100% Amirthakaraisal, T2 - 75% Amirthakaraisal and 25% Cow dung, T3 - 50% Amirthakaraisal and 50% Cow dung, T4 - 25% Amirthakaraisal and 75% Cow dung, T5 - 100% Cow dung, T6 – control (zero treatments). Treatments were applied two week interval according to the pot area. Growth and yield parameters were measured and analysed statistically using ANOVA and means were compared with DMRT at 5% significance level. The results proved that T3- 50% Amirthakaraisal and 50% Cow dung significantly ($P < 0.05$) increased the dry weight of shoot (27.27 %), number of pods per plant (31.03 %), weight of 100 seeds (29.78 %), total yield (33.73 %) in comparison to plants without application of organic manure(T6). T3 given best results when comparing with T1, T2, T4, T5 and also T3 plants were expose their 50% flowering 30 days after planting compared with other treatments. Therefore, it could be concluded with the final yield of *Vigna radiata* that application of 50% Amirthakaraisal and 50% Cow dung to soil increased the growth and yield performance of *Vigna radiata.
Keywords:* Amirthakaraisal, Cow Dung, Organic Fertilizer, Tropical, *Vigna radiata

I. INTRODUCTION

Vigna radiata is an annual important pulse crop that mainly grown in tropical, subtropical and temperate regions of Asia for example India, Bangladesh, Pakistan, Myanmar, Indonesia, Philippines, Sri Lanka, Nepal, China, Korea and Japan (Shanmugasundaram, 2001) *Vigna radiata* can grow well in extreme environments by using less amount of ingredients (Das *et al.,* 2014). *Vigna radiata* is an herbaceous, short-duration, flowering plant under the Leguminosae family. It has high protein content, essential minerals and also provides excellent green manure as a forage crop to livestock animals. *Vigna radiata* can fix the atmospheric N (58–109 kg/ha) in symbiosis with Rhizobium Like other legumes. *Vigna radiata* is not only used N for its purposes but also improves soil fertility (Ali and Gupta, 2012).

Vigna radiata crop productivity is more reliant on a sufficient supply of water than on any other single environmental condition. Currently, 6156 ha of land in Sri Lanka is used for *Vigna radiata* agriculture, with a national production of 7,355Mt. (Department of Census and Statistics, 2019). However, this crop's production is extremely low, due to its cultivation on the marginal ground with low fertilizer rates. Among the many obstacles, incorrect nutritional management is a significant flaw in enhancing bean output.

Due to their high K (Singh *et al*., 2016) and S (Singh and Sharma, 2016) requirements, legumes such as *Vigna radiata* have high potassium (Singh *et al.,* 2016) and sulphur (Singh and Sharma, 2016) demand. Its effect on photosynthesis, water usage efficiency, and plant resistance to diseases, drought, and cold, as well as making the balance between proteins and carbohydrates, sufficient levels of K are essential for boosting the yield and quality of various crops. Deficiencies in essential nutritional components have been the leading cause of crop losses (Kumar and Babel, 2011). As a result, nutritional components are required as a vital factor in enhancing growth, production, and quality, as well as a factor in lowering the negative environmental impact (Magen, 2008). The global population is very large, and it need a large quantity of high-quality food in a short period of time. According to the United Nations (2009), global food production must twofold by 2050 to meet the expanding population's food needs.

Any development in the agricultural system that leads to increased productivity should lessen the system's negative environmental impact and improve its long-term viability. Fertilizer is used to resolve issues both of organic and inorganic origin (Nasab *et al*., 2015). Chemical fertilizers are being used by farmers to meet the rising demand for food. In this scenario, fertilizer research has become a prominent topic and has been increasingly relevant in recent years around the world (Arij, 1998). The quality of soil and food deteriorates as inorganic fertilizer is used indefinitely (Nasab *et al*., 2015). Organic manure enhances the capability of soil's physical condition and provides a

suitable amount of essential nutrients for soil productivity. Hence considering this an experiment was conducted with the objective of to investigate the effects of combination of Amirthakaraisal and Cow dung on the growth and yield of *Vigna radiata* (cv. MI 5)

II. METHODOLOGY

A. Experimental Location

An experiment was conducted at the home garden of Thettativu, Batticaloa, Sri Lanka which is located in the latitude of 7°33'41.3"N and the longitude of 81°47'08.8" E, from July 2021 to September 2021. The area falls under the Agroecological region of Low Country Dry Zone in Sri Lanka. The soil type is sandy rego soil in this location.

B. Planting of Seeds

The pots were filled with topsoil: Compost in the ratio of 1:1 and a distance of 5cm was left unfilled from the top of the soil to facilitate irrigation. Seeds of *Vigna radiata* cultivar 'MI 5' was used for this experiment and seeds were collected from the sales center of Agrarian Development Center, Kaluwanchikudi.

C. Treatment Structure

Two different organic fertilizers were tested as a combination. The experimental units were arranged in the CRD manner. There were six treatment combinations and ten replications. Department of Agriculture recommended fertilizer application was used and a control and the treatment combinations were used as follows

T1 - Amirthakaraisal 100%
T2 - Amirthakaraisal 75% + Cow dung 25%
T3 - Amirthakaraisal 50% + Cow dung 50%
T4 - Amirthakaraisal 25% + Cow dung 75%
T5 - Cow dung 100%
T6 - Control

D. Preparation of Amirthakaraisal

Cow dung, cow urine, jaggery, clean water were added into plastic container. All ingredients were mixed well and covered. After that it was mixed twice a day (morning and evening) in the clockwise direction (morning and evening) in order to activate microorganism. The solution was filtered using cotton cloth after 24 hours of preparation. Finally, Amirthakaraisal was diluted 10 times with water and apply to plants.

E. Fertilizer Application

Fertilizers were applied according to the treatment structure. Department of Agriculture, Sri Lanka recommended organic fertilizers were used in this experiment and Top dressing was carried out at 4th week after seeding. The Amirthakaraisal was mixed with small amount of soil and cow dung directly applied to soil. The treatments were applied once in two week interval. The recommendations were as follows

TABLE I FERTILIZER RECOMMENDATION

Basal and top dressing	
Compost	10 ton/ha
Treatments	
Cow dung	10 ton/ha
Amirthakaraisal	500 l/ha

(Source: Department of Agriculture; Swaminathan and Nandhakumar, 2011)

F. Data Collection

Dry weight of shoot (g), days to take 50% flowering, total number of nodules, weight of nodules (g), weight of 100 seeds (g) andtotal yield were measured after the harvesting stage of the plant.

G. Statistical Analysis

Treatments effect were determined by Analysis of Variance (ANOVA) and differences between treatments were determined by using Duncan Multiple Range Test (DMRT) at 5% significant level by using SAS 9.4 software.

III. RESULTS AND DISCUSSION

A. Dry Weight of Shoot (g)

As mentioned in table II, there was a significant difference ($P < 0.05$) was recorded in dry weight of shoot between T3 and other treatments (Table II). Maximum dry weight of shoot was recorded in T3. This might be due to the application of Zn influence the growth of shoots (Kazemi, 2013). Number of leaves per plant play the major role on dry weight of shoots and it might be supported by Blade *et al.,* (1997) where they stated that higher plant population has limited solar radiation captured by plant leaves, number of leaves, leaf area while limiting shoot biomass.

B. Number of Nodules

Table II showed that combination of Amirthakaraisal and Cow dung significantly ($P<0.05$) influenced the total number of nodules in *Vigna radiata.* There was a significant difference recorded between T3 and other treatments. When considering the mean value, the maximum number of nodules were recorded in T3 and minimum number of nodules were recorded in T6 (control). The treatment T3 increased 46.27% number of nodules per plant compared to T6 (control) at 8 WAP.

The nodules formation depends on the availability of P and N on the soil which is supported by the finding of Salvagiotti *et al.,* (2008) where they proved the interaction between plant- available soil N requirements for nodules formation in cowpea. Stamford *et al.,* (2003) also said if the

soil had satisfactory level of available P and K will increase the nodule formation. Cow dung which is the part Amirtha karaisal and also one of the combinations of T3, contain exchangeable K (Tasneem *et al.,* 2004; Hossein, 2014). Piraveena and Thayamini. (2013) stated micronutrients for nodulation may be released by cow dung. Cow dung is important for nodules formation. when cow dung is applied alone, poor supply of P available in soil (Piraveena and Thayamini, 2013). In this experiment combination of 50% Amirthakaraisal and 50% Cow dung application in T3 gave highest total number of nodules in *Vigna radiata.*

C. Weight of Nodules (g)

Table II showed that combination of Amirthakaraisal and Cow dung significantly (P<0.05) influenced the weight of nodules in *Vigna radiata*. There was a significant difference recorded between T3 and other treatments. When considering the mean value, the maximum weight of nodules was recorded in T3 and minimum weight of nodules was recorded in T6 (control). The treatment T3 increased 37.96% weight of nodules compared to T6 (control) at 8 WAP. As a result, microbial activity is generally more in cattle manure that was applied to the soil for the decomposition of organic matter. It increased the nodules development in T3 and this results supported by Tippannavar *et al.,* (1990) where they stated Farmyard Manure treated soils had higher population of Azotobacter and Rhizobium.

Microbial activity boosts nodule N fixation which also increased weight of nodules in T3 and this results supported by Salvagiotti *et al.,* (2008) where they stated the formation of nodules is aided by the presence of P and N. Also, Stamford *et al.,* (2003) stated there is an interaction between plant-available soil N needs and nodule development in cowpea. In this experiment combination of 50% Amirthakaraisal and 50% Cow dung application in T3 gave highest weight of nodules in *Vigna radiata.*

TABLE II COMBINATION OF AMIRTHAKARAISAL AND COW DUNG ON THE DRY WEIGHT OF SHOOT (G), NUMBER OF NODULES AND WEIGHT OF NODULES

Treatments	Dry weight of shoot(g)	No. of nodules	Weight of nodules (g)
T1	27.10 ± 1.87 [b]	39.50 ± 4.21 [b]	1.66 ± 0.17 [b]
T2	29.50 ± 1.25 [b]	44.00 ± 3.75 [b]	2.00 ± 0.35 [b]
T3	33.60 ± 0.85 [a]	61.80 ± 10.21 [a]	2.95 ± 0.55 [a]
T4	29.50 ± 1.10 [b]	41.50 ± 6.62 [b]	1.89 ± 0.18 [b]
T5	29.00 ± 1.04 [b]	40.00 ± 3.14 [b]	1.78 ± 0.16 [b]
T6	26.40 ± 1.05 [b]	28.60 ± 4.24 [b]	1.12 ± 0.13 [b]
F - test	*	*	*

Value represents mean ± standard error of 10 replicates.
ns: not significant; *: P<0.05 Represents significant at 5% level of probability. Mean values in a column having the dissimilar letter/letters indicates significant difference at 5% level of significance by Duncan's Multiple Range Test.

D. Days to Take 50% Flowering

Days to take 50% flowering significantly varied (P<0.05) due to the combination of Amirthakaraisal and Cow dung application. All the data's shown in table III. Minimum duration of 30 days was taken by T3 to attain 50 % flowering respectively. Maximum time period of 35 days was taken in T6 for 50% flowering respectively. T3 was shown high plant height, higher number of leaves where vegetative growth was achieved early, that plant quickly emerged the flowers as well as these results supported by Obedoni *et al.,* (2005) where they stated especially at later stages in cowpea growth could be responsible for the differences in days to 50% flowering.

Application of 50% Amirthakaraisal and 50% Cow dung has induced early flowering in *Vigna radiata.* The elements which contains in Amirthakaraisal and Cow dung such as micronutrients P, K and N thus out of those elements P is the main element which directly induce early flowering (Shreenivasa *et al.,* 2011). Amirthakaraisal have plant growth regulators and micro and macro nutrients induce the activity of plant growth (Sethuraman, 2002). This result of this study supported by Khosa *et al.,* (2011) where they were proved that presence of macro nutrients in fertilizer quickly emerge the flower. And Bottini *et al.,* (2004) stated that gibberellin enhance the flowering.

Cow dung have K and P nutrients (haliru *et al.,* 2015). The application of potassium fertilizer increases the emergence of flowers in the plants. K plays major role in flowering Fan *et al*., (2001). These statements were supported this experiment results. Gudugi, (2013) also stated that application of different rates of cow dung perform well to enhance the 50% flowering in okra. In this experiment combination of 50% Amirthakaraisal and 50% Cow dung application in T3 quickly enhanced the flowering in *Vigna radiata.*

E. Weight of 100 Seeds (g)

The data revealed that combination of Amirthakaraisal and Cow dung significantly ($p < 0.05$) affected the weight of 100 seeds of *Vigna radiata* (Table III). The data showed

that application of 50% Amirthakaraisal and 50% Cow dung fertilizers had significantly increased the weight of 100 seeds per plant when compared to other treatments. Amirthakaraisal and Cow dung have lots of minerals which helps to increase the 100 seed weight and this might be supported by Ziaeian and Malakouti, (2001) where they stated addition of Zn, Mn, and Cu application considerably increased 1000 grain weight. And there was a considerable increase in 100 grain weight with the treatment of micronutrients (Grotz and Guerinot, 2006).

F. Total Yield (Ton/Ha)

Total yield of *Vigna radiata* (ton/ha) is shown in Table III. It was noted that only the T3 produced the highest total yield. The T3 treatment was significantly different from other treatments. The total yield is high in 50% Amirthakaraisal and 50% Cow dung treatment which recorded 2.22 ton/ha. Combination of 50% Amirthakaraisal and 50% Cow dung application of T3 gave highest yield in this experiment. The application of P containing fertilizers increased the yield in T3 and this might be supported by Sridhar *et al.,* (2000) where they stated that rate of P application for obtaining high yield of soybean may be from 50 kg/ha to 56.25 kg/ha in hill zone of India. Several researchers also reported the application of P containing fertilizer increased the yield in crops (Cassman *et al.,* 1981; Jones *et al.,* 1997; Magani and Kuchinda, 2009).

Organic practices had increased the yield in crops like chilli (Subhashini *et al.,* 2001), moringa (Beaulah*,* 2001), green gram (Somasundaram *et al.,* 2003) and French beans (Selvaraj, 2003). Similar results also found in this experiment where the application of 50% Amirthakaraisal and 50% Cow dung in T3. Organic manure application has improved the soil's structure and its ability to hold water and minerals.

Organic manure contains microorganisms that break down and release nutrients into the soil. These bacteria get their energy from decomposing plant and animal debris, which provides the soil with a complete package of nutrients (Anjali *et al.,* 2017).

N application increased the growth and yield of the plant in T3 and it might be supported by Dhama *et al.,* (2005) where they stated composted cow dung is rich in total N (0.74%) including some hormones and its favours to plant growth. The results obtained in this study is due to the presence of micro and macro nutrients which increased yield in T3. Increased fertilization of N and P play a critical role in pollen viability (Saeed *et al.,* 2012) as a result, the number of pods and their setting have grown (Dixit and Elamathi, 2007). Therefore, in this experiment total yield of *Vigna radiata* in T3 has been increased by 33.73% over T6 (control).

TABLE III COMBINATION OF AMIRTHAKARAISAL AND COW DUNG ON THE50% OF FLOWERING, 100 SEED WEIGHT (G) AND TOTAL YIELD (TON/HA)

Treatments	50% of flowering	100 Seed Weight (g)	Total Yield (ton/ha)
T1	35.00 ± 0.29 ^{ab}	9.00 ± 0.36 ^{b}	1.78 ± 0.06 ^{b}
T2	32.20 ± 0.48 ^{c}	9.58 ± 0.13 ^{b}	1.94 ± 0.08 ^{b}
T3	30.80 ± 0.32 ^{d}	10.98 ± 0.64 ^{a}	2.22 ± 0.05 ^{a}
T4	33.90 ± 0.31 ^{b}	9.52 ± 0.53 ^{b}	1.88 ± 0.06 ^{b}
T5	34.20 ± 0.53 ^{b}	9.31 ± 0.13 ^{b}	1.80 ± 0.13 ^{b}
T6	35.50 ± 0.16 ^{a}	8.46 ± 0.33 ^{b}	1.66 ± 0.10 ^{b}
F - test	*	*	*

Value represents mean ± standard error of 10 replicates.
ns: not significant; *: P<0.05 Represents significant at 5% level of probability. Mean values in a column having the dissimilar letter/letters indicates significant difference at 5% level of significance by Duncan's Multiple Range Test.

V. CONCLUSION

According to this study, 50% of Amirthakaraisal and 50% Cow dung significantly increased the dry weight of shoot (27.27%), days to take 50% flowering (86.76%), Number of nodules (46.27%), weight of nodules (37.96%), weight of 100 seeds (29.78%), total yield (33.73 %). Therefore, the 50% of Amirthakaraisal and 50% Cow dung fertilizer could be recommended for the cultivation of *Vigna radiata* in order to increase the growth and yield which is environmental-friendly for Sustainable Agriculture.

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