Universe International Journal of Interdisciplinary Research
(International Peer Reviewed Refereed Journal)
DOI No. – 08.2020-25662434

© UIJIR | ISSN (O) – 2582-6417
OCT 2023 | Vol. 4 Issue 5
www.uijir.com

EFFECTS OF POTASSIUM LEVELS ON GROWTH, YIELD, AND QUALITY OF CURCUMA *CURCUMA AERUGINOSA* ROXB. IN NORTH VIETNAM

Author's Name: Nui Van Dao[1] , Hung Ba Nguyen[1], Ha Thi Dang[1], Hai Dai Tran[1], Khanh Xuan Nguyen[1], Thu Thi Phan[1*], Tai Van Nguyen[2].

Affiliation:

1. Hanoi Research Centre for Cultivating and Processing of Medicinal Plants, National Institute of Medicinal Materials (NIMM), Hanoi, Vietnam
2. Department of Phytochemistry, National Institute of Medicinal Materials (NIMM), Hanoi, Vietnam

Corresponding Author Name: Thu Thi Phan, phanthu.vdl@gmail.com

ABSTRACT

Curcuma aeruginosa *is a medicinal plant and essential ingredients in Vietnam traditional medicine. Potassium fertilizer (K) is one of major factor was effect to accumulation of active ingredients on root of plant and overusing chemical fertilizer cause reducing the quality of the products. The goal of study is to find the potassium fertilizer formula suitable for growth and development of* Curcuma aeruginosa *plant in Vietnam. This study was carried out to find the potassium fertilizer formula suitable for growth and development of* Curcuma aeruginosa *plant in Vietnam. The result showed that potassium fertilizer with K2 treatment 180 kg K/ha could help* Curcuma aeruginosa *Roxb to achieve high yield and quality with germination rate reached 80%, the average yield 10.50 – 10.68 tons/ha. The content of Germacrom, Curdion and Furanodiene was 1.11, 0.19 and 0.10 respectively. The content of essential oil was 3.06 ml/100g. The results in the present study also could suggest for the production of* Curcuma aeruginosa *Roxb obtain the high quality medicinal material in the future.*

Keywords: Potassium, Curcuma aeruginosa Roxb, growth, yield, essential oil

DOI Link :: https://doi-ds.org/doilink/11.2023-61594791/UIJIR

INTRODUCTION

Curcuma aeruginosa is a member of the Zingiberaceae family and known with other name as Turmeric. Curcuma aeruginosa roots as medicine and has a hot and spicy taste. It has been used as a medicine in several East Asian countries for more than 2000 years, especially in China. Turmeric has the scientific name Curcuma aeruginosa Roxb. The plant grows in mountainous or wild areas such as Indonesia, Malaysia, Cambodia and China. In Vietnam, Curcuma aeruginosa grows in some provinces as Ha Giang, Hung Yen, Hanoi, Thai Binh... The functions extract from root of Curcuma aeruginosa were used to treat blood stasis, abdominal pain, enlarged liver and spleen, menstrual cramps, indigestion, and indigestion (Pham, 2009 and Do et al., 2006).

The botanical characteristics of *Curcuma aeruginosa* Roxb. In difference potassium level was described as Fig 1A, B.

More than 50 substances have been identified in the root of plant. In which, the main compounds have good effects in treatment disease such as 1,8-cineole, curzerenone, furanogermenone, camphor, (Z)-3-hexenol, furanodienone, curcumenol, isocurcumenol and β-elemene were detected by Jirovetz (Jirovetz et al., 2000).

The using HPLC method to analysed root of plant showed that the compound of Curcuma aeruginosa contain total camphor, curzerenone and epicurzerenone concentrations of 16.85%, 16.81% and 3.5%, respectively (Aromdee et al., 2011).

In addition, the demand of Curcuma aeruginosa will be increase in market but the wild resources are sharply decrease by overexploitation of humans. At the same time, Fertilizer and cultivar methods are problems cause to low yield and quality. Arcoding Pandey et al. (2019) with increased soil test values of N, P and K the amount of fertilizer needed for cowpea decreased. Ortherwise, application of nitrogenous phosphatic and potassium fertilizers was control besides improving soil physico-chemical and biological properties decreased the environmental risk (Trivedi et al., 2020). Recent, application of GACP in cultivation and production of medicinal herbs is to ensure the quality of Vietnam medicinal materials and control various factors that affect the quality of medicinal materials plant. Numerous researcher indicate that optimal amount of fertilization was obtained by establishing mathematical models may be increase yield and quality of plant (Pandey et al. 2019 and Trivedi et al., 2020) , but there are not many studies on medicinal plants.

Results of analysis of NPK content in the roots of turmeric root: the amount of N is from 1.260 to 1.873%; amount of P from 0.166 to 0.232%; K content from 1.197 to 1.549 % (Hua et

DOI Link :: https://doi-ds.org/doilink/11.2023-61594791/UIJIR

al., 2008)

One research recently also indicated that application of 150 kg N/ha could help *Curcuma aeruginosa* to achieve high yield and quality with germination rate reached 80%, the time from planting to finishing sprouting was 20-25 days, time from planting to harvesting was from 252 to 260 days; The average plant height was 184.89 cm; number of leaves/main stem was 9-10 leaves; The average number of branch/cluster was 3-4 branch; the average yield was 8.87 - 10.37 tons/ha (Chai et al., 2011; Nguyen et al., 2022).

Although Fertilizer and cultivar play a major role to yield and quality of Curcuma aeruginosa medicinal content, study on Curcuma aeruginosa plant are very limited. Therefore, the expand the area production of Curcuma aeruginosa plant is necessary to have more research to complete the commercial cultivation process in the future. In this study, we evaluate the effect of potassium dose on growth, yield and quality of Curcuma aeruginosa medicinal plant in Hanoi to contribute to the development of the growing process. The mount of postassium fertilizer quality of medicinal herbs in Ha Noi with the formula level of fertilizer has selected 180 kg K_2O gives the highest camphor, curzerenone and epicurzerenone content among different of Curcuma aeruginosa cultivars using HPLC method and it is main objectives of this study.

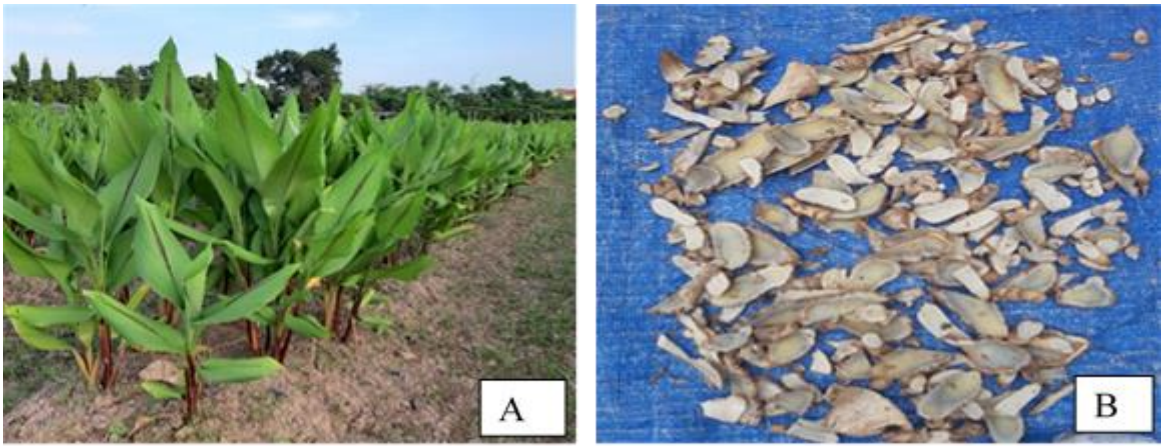

Figure.1. A. Curcuma aeruginosa plant in the different potassium fertilizer treatment experiment

B. The *Curcuma aeruginosa* Roxb. dry root was used as a traditional Vietnam medicine

DOI Link :: https://doi-ds.org/doilink/11.2023-61594791/UIJIR

MATERIAL AND METHODS

Field experiments of this study was carried from 2021 to 2022 at Research Center for Medicinal Plants Hanoi, Vietnam (RCMP).

Experimental material and site

Experimental material Curcuma aeruginosa Roxb. variety was collected from Thai Binh and used in experiments, which was regarding productive performance in the Hanoi climatic conditions of Vietnam.

National Institute of Medicinal Materials have coordinates at (20°53′ N, 105°44′E, 20 m asl), Thanh Tri, Ha Noi capital, Vietnam. The site locate was in a subtropical monsoon climate zone with Daily mean temperature and solar radiation during the *Curcuma aeruginosa* grow were 25.4 °C and 12.3 $MJm^{-2}d^{-1}$, respectively. The soil in field *Curcuma aeruginosa* paddy field were taken from the research farm. The soil was in texture with pH 6.62 and soil character of the experiment sites was analysed and presented in table 1.

Experimental treatment and design

In this tudy, two experiments were designed such as:

Experiment 1: Determining the amount of potassium absorbed by Curcuma aeruginosa and the amount of potassium in the soil (Page et al., 1982).

Sample was colected at the time of plant death with yellow leave (including 2 stems and 2 tubers), calculate the dry matter content and the potassium content (%) in the harvested product. All colecting samples was separed each part (stems and roots) for analyse processing; The root part is washed and the stem samples were cut into pieces of 3-5 cm long, the rhizome samples were sliced and dried at 70 ^{o}C.

Take 2 soil samples before planting the nutrition experiment of *Curcuma aeruginosa* Roxb.

Total Potassium (%) (TCVN 4053:1985) was analyzed according to Flame photometer method at the Institute of Soil and Agrochemistry.

To determine the content of N, P, K in the roots of Curcuma aeruginosa:

Calculate the dry matter content and the content of N, P, K (%) in the harvested product amount of K absorbed by the turmeric plant according to the formula:

Amount of K absorbed = total mass of biomass x dry matter accumulation rate (%) x K content in turmeric sample (%).

To Determination of K in the soil. Soil sampling method: Comply with regulations on

DOI Link :: https://doi-ds.org/doilink/11.2023-61594791/UIJIR

agrochemical sampling. Number of soil samples: Take 2 soil samples before planting for experiments on nutrition of Turmeric (analyzed at the Institute of Soil and Agrochemistry).

Analytical method: Total protein (%) (TCVN 6498:1999): Kjeldahl method; Total phosphorus (%) (TCVN 8940:2011): Photometric method (Spectrophotometer); Total Potassium (%) (TCVN 4053:1985): Flame photometer.

Experiment 2: The effect of potassium level on growth, yield and quality of *Curcuma aeruginosa* Roxb.

Total formula in this experiment was conducted from the result of the nitrogen based on the analization of *Curcuma aeruginosa absorbed* in experiment 1.

The experiment was consisted of 4 K treatments as *K0 (CK): 0 kg K_2O; K1: 150 kg K_2O; K2: 180 kg K_2O; K3: 210 kg K_2O respectively*. Three replications *of each treatment* was arranged in a randomized complete block design (RCBD). The area of each experimental plot was $10m^2$.

Non-experimental factors: Planting distance 30 x 30cm. N and P formula was 150 N and 200 P for all treatments. Planting season in March - April. After harvesting, the bulbs are stored in a shady place until the planting season.

Growth and yield analysis

Growth indexes included growth time, plant height and stem diameter of *Curcuma aeruginosa* Roxb. plants were recorded at harvest such as: Germination time (days); Planting-to-harvest time (days); The plant height (cm) was measured from root to tip of growth (once a month); Number of leaves/plant (leaves/plant); Count the number of leaves in each month of tracking; Number of branches/plant (branches): Count the number of branches/clumps for each month of monitoring.

Biomass yield (tuber yield) were determined in each plant. The fresh biomass and dry tuber yield per plant were determined using one digital scale with precision of 0.01 g. Dry tuber had an important role in determination of Curcuma aeruginosa quality.

Yield components were caculated via Number of clusters/m^2, Number of trees/m^2; Individual yield (g/plant), theoretical yield (ton/ha), Actual yield (ton/ha) and dry matter yield (kg/ha) respectiverly.

Measurement of Curcuma aeruginosa Roxb Content

Chemicals and materials: Acetonitrile (HPLC grade), deionized water. Ruranodiene was purchased from Shanghai Yuanye Bio-Technology Co., Ltd. (CAS: 19912-61-9, HPLC ≥ 98%). Curdione and Germacrone were isolated in the laboratory from *Curcuma aeruginosa* Roxb

DOI Link :: https://doi-ds.org/doilink/11.2023-61594791/UIJIR

using column chromatography and their purity was determined by NMR.

Instrumentation and analytical conditions: Phytochemical analysis was conducted to identify major active compounds by using the high performance liquid chromatography (HPLC) method, using an LC-20AD apparatus (Shimadzu Corp, Kyoto, Japan). The experiments were carried out using a reversed phase C18 Cosmosil column (250 mm × 4.6 mm; Nacalai Tesque Inc.). The samples were eluted with a stepwise elution of the mobile phase with solvent A (H_2O) and solvent B (acetonitrile), at a unique flow rate of 1 mL/min. The gradient elution program was as follows: 0 min 70% A:30% B; 15 min 53% A:47% B; 30 min 53% A:47% B; 40 min 40% A:60% B; 50 min 10% A:90% B, 60 min 0% A:100% B, 75 min 0% A:100% B, 90 min 70% A:30% B, 100 min 70% A:30% B. The sample injection volume was 20 µL and monitored with an SPD-20 A (UV) at 214 nm. The chromatographic peaks were confirmed by addition of standard compounds and comparing their retention times with those of the reference compounds. The amount of each compound in the extract was calculated from their standard curves. The HPLC analysis was performed in triplicate.

Preparation of standards: The standard solutions were prepared by dissolving in methanol and transferring in a volumetric flask and making up the volume using methanol to obtain the mixed standard solution of curdione (1.700 mg/mL), germacrone (0.720 mg/mL), and furanodiene (0.330 mg/mL). These stock solutions were further diluted to final concentrations of 0.085 – 1.700 mg/mL with curdione, 0.036 – 0.720 mg/mL with germacrone, and 0.0165 – 0.330 mg/mL with furanodiene in methanol and stored at 4 ºC until use.

For sample preparation, Curcuma aeruginosa root were dried at 45 ºC by freeze-drying. Then, the samples were finely ground prior to extraction. Five hundred milligrams of the dried sample were extracted in 10 mL of methanol in an ultrasonic bath at room temperature for 30 min. After extraction, the sample solutions were filtered through a 0.45 µm membrane filter and injected into the chromatograph.

Quantification of essential oil content by steam distillation method (Attachment 12.7 VP V).

For test article solution preparation, curcuma aeruginosa were dried at 45 ºC by freeze-drying and powdered. 30 g powder of *Curcuma aeruginosa* Roxb, and added 500 ml in to flask of the medicinal essential oil dosing kit. And then Add 300 ml of water and continue to distill for 3 hours to measured.

Statistical Analysis

Data was analyzed using CropStat 7.2. and Excel 2010 software, and then strain and variety

DOI Link :: https://doi-ds.org/doilink/11.2023-61594791/UIJIR

fertilizing amount were included as experimental factor to calculate the significant difference of oil content in Curcuma aeruginosa plant.

RESULT AND DISCUSSION

Determining the potassium level nescessary of Curcuma aeruginosa plant

Analyse Contents of N, P, K in nutrient experiment field soil

To determine the potassium content in the soil for planting Curcuma aeruginosa plant in Thanh Tri, Hanoi, soil samples were taken to analyze K_2O content at the Institute of Soil Chemistry and Agrochemistry. The results of the study are described in Table 1.

Table 1. Potassium nutrient in the experiment field

Criterial	Sample		Average	K content in the soil (kg/ha)
	Sample Soil 1	Sample Soil 2		
K_2O (mg/100g)	6.25	6.53	6.39	154.22

The goal of this experiment to Determine the nutrient content in the soil to assess the supply capacity for plant. Soil samples were taken after harvesting the sample Ivy (*Leonurus japonicus* Houtt), which absorbed nutrients from the soil and facilitated uniformity between treatments as well as between replicates. The results after analysis show that the two soil samples are relatively uniform.

The results showed that the availabal potassium content in soil samples was 6.25 - 6.53 mg/100g. The soil was poor potassium nutrient (the amount of availabal potassium less than 10 mg/100g was the potassium-poor soil according to the division scale of Soil Science Society, 2000). The amount of K in the soil is about 154.22 kg/ha.

Determination of the amount of potassium absorbed by Curcuma aeruginosa from the field

In order to determine the dosage of K_2O for the experiment on the response of turmeric to potassium, the study took samples of leaves and rhizomes of turmeric at the time before the plant died to calculate the amount of K_2O present in the plant. samples. The results are shown in Table 2.

DOI Link :: https://doi-ds.org/doilink/11.2023-61594791/UIJIR

Table 2. Content of potassium absorbed by *Curcuma aeruginosa* Roxb. from the field

Number	Part	DM (%)	Dry yield (t/ha)	Fresh yield (t/ha)	Total Potassium (%)	Total amount of Potassium up take (kg/ha)
1	Leaf stem	29.94	33.70	10.09	0.70	70,63
2	Tuber	33.20	22.80	7.57	1.50	113,55
Total		-	-	-	-	184.18

The K_2O content in the root of Curcuma aeruginosa grown in Hanoi is 1.50%. According to Rahardjo et al., when analyzing the K_2O content in turmeric roots, copper ranges from 1.197 to 1.549 % (Rahardjo et al., 2000). The result can be indicate that the K_2O content in the root of Curcuma aeruginosa grown in Hanoi is equivalent to results of Rahardjo was analysis and grown in Indonesia.

Based on the analysis results of potassium content and yield of leaves, rhizomes, the project calculated the amount of potassium from the field as 184.18 kg K_2O/ha.

From the results of analysis of K_2O content in soil samples and Curcuma aeruginosa samples. To evaluate the response of turmeric to nitrogen doses and suitable amounts of nitrogen for plants to achieve the highest yield and quality, we conducted experiments with four formulas application from 0 K_2O (CK), 150 K_2O, 180 K_2O, 210 K_2O per hecta.

Effect of potassium dosage on growth, development, yield and quality of Curcuma aeruginosa plant

Effect of potassium dose on growth rate of Curcuma aeruginosa

To evaluate the effect of potassium dosage on the germination rate of Curcuma aeruginosa in experimental formulas grown at the Hanoi Center for Research in Planting and Processing Medicinal Plants, the study monitored the data and processed the results. The result of this study was shown in Table 3.

DOI Link :: https://doi-ds.org/doilink/11.2023-61594791/UIJIR

Table 2. Effect of different potassium adosage on growing rate of Curcuma aeruginosa Roxb.

Treatment	Year 2021		Year 2022	
	Growth rate		Growth rate	
	%	√x+0,5	%	√x+0,5
K0	85.82	9.76	83.98	9.66
K1	80.70	9.53	85.67	9.76
K2	84.31	9.73	88.31	9.90
K3	87.73	9.86	90.89	10.03
$LSD_{0,05}$	-	*0.83*	-	*0.64*
CV (%)	-	*10.2*	-	*7.8*

Note: *K0: 0 kg K_2O; K1: 150 kg K_2O; K2: 180 kg K_2O; K3: 210 kg K_2O.*

The results in Table 3 showed that there was no interaction between different fertilizer treatments to growth rate of *Curcuma aeruginosa* Roxb with LSD 95% confidence. All data are means ± SD calculated from three replicates. Three biological experiments were performed, which produced similar results. Germination rate in the experimental treatments over 2 years of follow-up 2021 and 2022 was in the range of 70 - 100%, so the data were converted before statistical processing.

Effect of Potassium doses on growth parameters of Curcuma aeruginosa Roxb.

The difference in fertilizer uptake affected in growth may be because of the higher absorption of water and mineral nutrients due to extensive colonization of roots or tuber (Benhmimou et al., 2017).

To evaluate the effect of potassium dosage on the growth parameters of *Curcuma aeruginosa*, the study analyzed criteria such as Plant height, number of leaves/main stem, number of trees/clump. The growth parameters were measured before the plants wither and were showed in Table 4.

DOI Link :: https://doi-ds.org/doilink/11.2023-61594791/UIJIR

Table 3. Effect of Potassium doses on growth parameters of Curcuma aeruginosa

Treatment	Year 2021			Year 2022		
	Plant height (cm)	Number of leaves/ main stem	Number of plants/ cluster	Plant height (cm)	Number of leaves/ main stem	Number of plants/ cluster
K0	161.71	9.85	3.69	170.38	10.18	3.39
K1	171.55	9.99	4.56	176.02	10.18	4.36
K2	176.26	10.23	4.62	179.98	10.10	4.43
K3	174.12	10.47	4.83	181.33	10.14	4.41
$LSD_{0,05}$	*3.66*	*0.85*	*0.45*	*2.73*	*0.59*	*0.35*
CV (%)	*12.6*	*10.0*	*12.1*	*12.3*	*16.9*	*10.0*

Note: *K0: 0 kg K_2O; K1: 150 kg K_2O; K2: 180 kg K_2O; K3: 210 kg K_2O.*

In the growing period of the plant, potassium is developed with higher percentage in the young parts and active organs than the old parts (Chandrashekhar and Hore. 2019 ; Taiz et al., 2015). When the soil does not provide enough potassium, the potassium in the old parts is transferred to the young parts. The organs active more than to ensure the normal physiological activities of the plant. Therefore, the plant will quicly winther. The results of the 2-years showed that different of potassium doses applied on Curcuma aeruginosa plants affect to the height of the plants, the number of leaves/plant and the number of plant/cluster (Taiz et al., 2015). The difference is statistically significant with the reliability at 95%. In which, the potassium level of 180 - 210 kg/ha were not difference with statistical significance, but the difference was statistically significant compared with the level of 0 - 150 kg/ha.

Influence of different Potassium dosage on yield and quality on Curcuma aeruginosa Roxb.

The different genotypes and heredity characteristics account for 80% on yield and quality of plant. The manining percentage is affeted by cultivation and administration such as application of fertilizer (Li *et al*., 2011). In this study, the results in Table 5 showed that *Curcuma aeruginosa* responded differently potassium *dosage* to the yield components and yield of medicinal plant, the difference is statistically significant with the degree of 95% confidence. All data are means ± SD calculated from three replicates. Three biological experiments were performed, which produced similar results.

DOI Link :: https://doi-ds.org/doilink/11.2023-61594791/UIJIR

Table 4. Effect of different Potassium dosage on components of yield and yield in Curcuma aeruginosa Roxb.

Treatment	Year 2021			Year 2022		
	Individual weight (g/plant)	Fresh/ Dry Ratio	Dry yield (tonnes /ha)	Individual weight (g/plant)	Fresh/ Dry Ratio	Dry yield (tonnes /ha)
K0	938.00	3.12	7.39	825.17	3.21	7.49
K1	1,033.42	3.16	8.59	962.92	3.15	9.04
K2	1,133.92	3.31	10.29	1,086.50	3.32	10.43
K3	1,166.75	3.45	10.50	1,157.50	3.20	10.68
$LSD_{0,05}$	*28.12*	-	*0.35*	*48.07*	-	*0.45*
CV (%)	*10.2*	-	*9.7*	*10.7*	-	*10.7*

Ghi chú: *K0: 0 kg K_2O; K1: 150 kg K_2O; K2: 180 kg K_2O; K3: 210 kg K_2O.*

The results of the 2-year follow-up showed that different doses of potassium applied to turmeric plants affect The biomass yield of Curcuma aeruginosa was highest at application of 150 kg K/ha (Table 5) and was not significant different between K2 and K3 treatment with the potassium level of 180 - 210 kg per hecta. So K1 was maybe suitable for Curcuma aeruginosa Roxb. cultivated in Ha Noi. In which, the potassium level of 180 - 210 kg/ha did not differ with statistical significance, but the difference was statistically significant compared with the level of 0 - 150 kg/ha. Thus, the dose of potassium affects the yield of Curcuma aeruginosa.

Potassium efficiency *at different levels in Curcuma aeruginosa Roxb.*

The efficiency of fertilizer use of crops can be assessed through agronomic and physiological efficiency of fertilizers. In this study, the agronomic efficiency of fertilizers was evaluated and guatantee for high yield and quality of plant. The results was show in Table 6.

Table 5. The efficiency agronomic of Potassium fertilizer in *Curcuma aeruginosa* Roxb.

Treatment	Formula (kg/ha)	Commercial fertilizer (kg/ha)	Efficiency agronomic of fertilizer, year 2021 (Ai)*	Efficiency agronomic of fertilizer, year 2022 (Ai)*
K0	0	0	-	-
K1	150	250	4.80	6.20
K2	180	300	5.67	4.63
K3	210	350	0.60	0.60

Note: * Ai = (Nf – No)/F; (Ai is agronomic efficiency = agricultural product (main

DOI Link :: https://doi-ds.org/doilink/11.2023-61594791/UIJIR

product)/kg of nutrients or agricultural product per kg of commercial fertilizer; f is yield per fertilized plot. No: yield per plot not fertilized or CK), (Ministry of Agriculture and Rural Development, 2019). Potassium used is potassium chloride fertilizer.

The important problem in nutrition management is how to use nutrition most effectively. The amount of potassium supplied to plants during a growth around in the field from many different sources such as The amount of potassium remaining in the soil (available potassium and in organic matter) and the amount of potassium applied to the plants include organic sources and inorganic sources.

The result indicated that under different potassium fertilization application level, at 95% confidence level, two treatments include K1, K2 have significant differences in Curcuma aeruginosa plant compared with K0 treatment (without fertilizer application). The effectiveness of them were higher than the formula 210 K2O (350 kg potassium chloride) over 2 years of experiment .

Thus, The result in table 6 show that the applying fertilizer at K2 could increase efficiency of potassium and yield in Curcuma aeruginosa. Hence, application of K2 was more suitable for Curcuma aeruginosa cultivation.

Effect of different Potassium dosage on quality in Curcuma aeruginosa

In this study, as shown in table 7 Curcuma aeruginosa plants under three potassium fertilization treatment. After treatment, Curcuma aeruginosa Tube were collected for measurements of Total Curdion, Total Germacrom and Total Furanodiene content. The means and SD were calculated from three replicates.

Table 7. Effect of different Potassium dosage on quality in Curcuma aeruginosa Roxb.

Treatment	Curdion Content (g/100g)	Germacrom Content (g/100g)	Furanodiene Content (g/100g)	Essential oil content (ml/100 g)
K0	0.94	0.17	0.08	3.05
K1	1.13	0.18	0.10	3.19
K2	1.11	0.19	0.10	3.06
K3	0.93	0.17	0.09	2.87

For Curdion content, the active of Curdion ingredient between the phosphorus and

DOI Link :: https://doi-ds.org/doilink/11.2023-61594791/UIJIR

potassium dosage formulas is not sharly different. However, it can be seen that the content in the K2 formula was the highest (1.212 mg / 100g). Contrast, For Germacrom content, The content of Germacrom has a difference between the experimental formulas. The analytical results showed that the Germacrom content was highest in the formula K2 (0.245 ml/100g).

Similarly, for furanodiene content, K2 formula (0.120 mg/100g) obtained the highest yield of active ingredient furanodiene than other treatment in this experiment.

The analysis results showed that the essential oil content in the protein formulations was different. Formula K2 gave the highest results (3.70 ml/100g) with the remaining formulas.

From the research results, the evaluation shows that the most suitable amount of potassium fertilizer: 180kg K_2O/ha.

The essential oil content was analysis in table 7 showed that the essential oil content of *Curcuma aeruginosa* was significant difference between treatment. The essential oil in treatment K2 was highest oil content (3.70 ml/100g) in the 2nd year, it showed that the treamtment K2 (180 K) was the most stable. Therefore, the treatment K2 (180 K) was chosen as the most optimal application for Curcuma aeruginosa plant.

DISCUSSION

Providing and maintaining K at optimal rates is necessary to increase production and improve quality of plant (Sadanandan et al., 2002). This study shown that different treatments of potasium fertilizer had a significant effect on the growth, development, yield and quality in *Curcuma aeruginosa*. As we know, single chemical fertilizer application can increase yield but over used it also can reduce the crop quality. If there are authoritative tabulations of nutrient concentrations known to satisfy the genetic growth potential of many plant species (Srivilai et al., 2017). Therefore, in experiment one was conduce to nutrient content of Soil and plant absorb nutrients from soil to create suitable formula with three potasium application (White and Brown. 2010).

Results in the reseach also showed that the most suitable potasium dosage was at 180 kg K/ha. When using this dosage, the germination rate reached over 80%, time from planting, the average yield was 10.50 – 10.68 tons per ha and increased growth parameters as compared to control experiment. The measurements of Total Curdion, Total Germacrom, Total Furanodiene content and Essential oil content increase than privious study was 1.11, 0.19, 0.10 and 3.06 respectively. Therefore, applying suitable potasium amount can increase growth, development, yield and quality on *Curcuma aeruginosa* Roxb.

DOI Link :: https://doi-ds.org/doilink/11.2023-61594791/UIJIR

Optimizing *Curcuma aeruginosa* plant on cultivar via apply fertilizer, it can be targeted for the development yield, quality content and functional in the traditional medicine. In addition, their ability in the medical treatment need further studies in the future.

CONCLUSIONS

Based on the results and discussion, it was concluded that potassium fertilization dosage up to 180 kgha-1 has increased the yield of *Curcuma aeruginosa*. The yield of rhizomes per hectare reaches 10.50 – 10.68 tons.

ACKNOWLEDGMENTS

This research was financed by National Institute of Medicinal Materials (NIMM) at number contact 01/2020/HĐ-ĐTCS-TTNCCTHN. The authors also would like to acknowledge NIMM division of the genetic material aand laboratory for the Essential oil and Curdion, Germacrom and Furanodiene analysis.

REFERENCES

1. Aromdee C., S. Polrat and P. Wangsomnuek. 2011. Constituents of the rhizome of Curcuma aeruginosa and its DNA fingerprint. International Journal of Phytomedicine 3. p.198-203; Corpus ID: 49582003.
2. Benhmimou, A., M. Ibriz, Al. C. Faïz, F. Gaboun, A. Douaik, F.Z. Amchra, A. Khiraoui and M. Lage .2017. Effects of planting density and harvesting time on productivity of natural sweetener plant (Stevia rebaudiana Bertoni.) in Larache region, Morocco. International Journal of Plant Research 7 (4): 83-89. doi:10.5923/j.plant.20170704.01
3. Chai, Z.P，X.M. Wang ，X. Sun .2011． Influence of N，P，K with drip irrigation on yield and fruit quality of Huizao jujube. Journal of Fruit Science. P 28(2) : 229 - 233.
4. Chandrashekhar G and Hore JK 2019. Effect of growth and yield of the ginger with thecombination of organic, inorganic and biofertilizers J of Pharmacognosy and Phytochemistry 83: 1174-1176.
5. Do, H.B., Q.C. Dang, X.C. Bui, T.D. Nguyen, T.D. Do, V.H. Pham, N.L. Vu, D.M. Pham, K.M. Pham, T.N. Doan, T. Nguyen. 2006. Medicinal Plants and animal in Viet Nam, Science and Technics Publishing: HaNoi, VietNam, Part 2, P358–360.

DOI Link :: https://doi-ds.org/doilink/11.2023-61594791/UIJIR

6. Hua ,Y.G., Q.B. Chen and Z.M. Lin. 2008. Coupling effects of water and chemical fertilizers on Hevea brasiliensis Latex yield. Chinese Journal of Applied Ecology .P 19 (6) : 1211 - 1216 . PMID: 18808010.
7. Jirovetz, L., G. Buchbauer, C.Puschmann, M. P. Shafi and M. K. Geetha Nambiar. 2000. Essential Oil Analysis of Curcuma aeruginosa Roxb. Leaves from South India. Journal of Essential Oil Research. Volume 12 - Issue 1.doi:10.1080/10412905.2000.9712039
8. Li, G., L. Ma and Y. Shi. 2011. Effect of different potassium fertilizer on growth, development and yield of Stevia rebaudia. Sugar Crop China, pp:36-38
9. Nguyen, B.H., N.V. Dao, H.D.Tran, H.T. Dang, V.V. Trinh, T.T. Phan, T.V.Nguyen, H.N. Phung. 2022. Effects of nitrogen levels on growth, yield, and quality of Curcuma aeruginosa Roxb. Journal of Medicinal Materials, Vol. 27, No. 6, p. 378-384.
10. Page, A.L., R.H. Miller and D.R.Keeney. 1982. Methods of soil analysis: chemical and microbiological properties, Part 2. 2nd ed. In R. C. Dinauer, editor. Madison, Wisconsin, USA: American Society of agronomy press.181.
11. Pandey, R. N., V. K. Sharma, S. Chandra, and K. A. Chobhe. 2019. Soil test based integrated fertilizer prescription for targeted green pod yield of cowpea. Indian Journal of Horticulture 76 (1):118–23. doi:10.5958/0974-0112.2019.00017. 3.
12. Pham, H.H. 1999. An Illustracted Flora of Vietnam. Volum 3. Tre Publishing: Ha Noi, Viet Nam. p.455.
13. Rahardjo, I., M. Rosita and S.M.D. Darwati. 2000. Status of cadmium and rhizome yield of temuireng (*Curcuma aeruginosa* Roxb.) at different dosages of phosphate fertilize (Balai Penelitian Tanaman Rempah dan Obat, Bogor (Indonesia). Journal Littri. Vol 6, No. 2, September. Doi:10.24831/jai.v44i3.12762.
14. Sadanandan, A.K., Peter, K.V., and Hamza, S. 2002. Role of potassium nutrition in improving yield and quality of spice crops in India. p. 445-454. In Pasricha, N.S., and Bansal, S.K. (eds.) Potassium for sustainable crop production. Potash Research Institute of India, Dundahera, International Potash Institute, Zug, Switzerland. [Links]
15. Srivilai J , Waranuch N , Tangsumranjit A , Khorana N and Ingkaninan K (2017). Germacrone and sesquiterpene-enriched extracts from *Curcuma aeruginosa* Roxb. increase skin penetration of minoxidil, a hair growth promoter, Drug Deliv Transl Res. 2017 Nov 20. doi: 10.1007/s13346-017-0447-7.

DOI Link :: https://doi-ds.org/doilink/11.2023-61594791/UIJIR

16. Taiz L., E. Zieger, I.M. Moller, and A. Murphy. 2015. Plant physiology and development 6ed. Sinauer Ass. Inc
17. Trivedi, A., R. Bhattacharyya, D. R. Biswas, S. Das, T. K. Das, P. Mahapatra, D. K. Shahi, and C. Sharma. 2020. Long-term impacts of integrated nutrient management with equivalent nutrient doses to mineral fertilization on soil organic carbon sequestration in a sub-tropical Alfisol of India. Carbon Management 11 (5):483–97. doi:10.1080/17583004. 2020.1808766
18. White, P. J., and P. Brown. 2010. Plant nutrition for sustainable development and global health. Annals of Botany 105 (7):1073–80. doi:10.1093/aob/mcq085

DOI Link :: https://doi-ds.org/doilink/11.2023-61594791/UIJIR