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# Effect of integrated nutrient management on quality parameters of turmeric in an acid alfisol of Himachal Pradesh

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## ABSTRACT

**The field experiments were conducted during *kharif* 2004 and 2005 on Turmeric (*Curcuma longa* L.) variety T-12 at research farm of Department of Soil Science CSK HPKV, Palampur (H.P) on silty clay loam soil with eleven treatments including a control. The pooled results of two year indicated that maximum curcumin (3.31%) and oil content (2.85 %) were found in the treatment 100 % NPKS + 20t FYM $ha^{-1}$ as soil mulch. Whereas, starch (8.11 %), protein (4.92 %) and curing percentage (21.53 %) were found highest at 100 % NPKS + 20t FYM $ha^{-1}$ as soil incorporation.**

**Key words:** *Curcuma longa*, curcumin content, starch, protein, curing percentage.

## INTRODUCTION

Turmeric (*Curcuma longa* L.) is one of the vital spice crops and is an eminent indigenous herbal medicine. Ancient system of Indian medicine has fully documented the significance of turmeric in curing various diseases such as stomach disorders, leprosy, fever, dropsy, discharge from the ear, ulcer, liver disorders, wounds, burns and as a blood purifier (Kanwar, 8).The root of turmeric is bactericidal and its paste is used to cure skin infections. The antibacterial effect of turmeric is due to three principal compounds *viz*. curcumin, curcuminoids and aromatic oil, out of these, curcumin is the most active therapeutic ingredient. It is a yellow, crystalline substance, which is a phenolic antioxidant, the scavenger of free radicals, which account for curing many diseases including cancer. Turmeric oil finds wide relevance in the medicinal and pharmaceutical preparations as antiseptic agent and exhibits a wide array of biological activity such as antibacterial, anti-inflammatory etc.

(Khanna, 9). Cured material is utilized for flavouring and colouring of a variety of dishes on domestic scale as well as in food industries. The productivity and quality of turmeric is low in the acidic soils due to the presence of exchangeable aluminium and iron, fixation of phosphorus and leaching and runoff losses of the nitrogen and potassium in the high rainfall areas. Whereas, turmeric nutrient requirement is quite high due to shallow rooting and potential to produce large amount of dry matter per unit area. Application of the organic and inorganic fertilizers is indispensable as their conjunctive use stimulates the mineralization of the nitrogen and sulphur and dismisses the fixation of phosphorus and potassium in the acidic soils (Kamat *et al.,* 7 and Singh *et al.,* 16). Therefore, the present study was carried out to test the effect of organics, inorganics alone and in integration at different doses on the quality parameters of turmeric.

## MATERIALS AND METHODS

The experiments were conducted on Turmeric (*Curcuma longa* L.) variety T-12 at research farm of Department of Soil Science CSK HPKV, Palampur (H.P) during *kharif* 2004 and 2005. The crop was sown in last week of May during both the years with row to row and plant to plant spacing of 30 x 20 cm, respectively. The soil of the experimental farm was silty clay loam in texture with pH 5.6, organic carbon 11.8 g $kg^{-1}$, nitrogen 264 kg $ha^{-1}$, available phosphorus 16 kg $ha^{-1}$, available potassium 204 kg $ha^{-1}$ and available sulphur 12 kg $ha^{-1}$. The experiments were laid out in the randomized block design comprising eleven treatments including control with three replications. The treatments were control, 20t FYM $ha^{-1}$ as soil incorporation and as soil mulch, 100% NPK, 100% NPKS, 100% NPKS in combination with 10, 15, 20t FYM $ha^{-1}$ both soil incorporation and 100% NPKS with same doses of FYM as soil mulch. The various quality parameters *viz*. curcumin, starch, protein, essential oil content and curing percentage in the turmeric rhizome were estimated using standard procedures mentioned below:

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For estimation of curcumin content in turmeric rhizome finely ground turmeric powder samples (1 g) were extracted by refluxing over a water-cooled condenser with 100 ml of distilled alcohol (methanol) for 2½ hours. The extract was transferred to a 100 ml volumetric flask and volume was made to 100 ml with alcohol (methanol). It was then filtered and an aliquot of 2 ml was transferred to a 25 ml volumetric flask and made to 25 ml volume, mixed well and the absorbance of this solution was measured at 425 nm wavelength against blank made of alcohol (Manjunath *et al*., 11). For estimation of starch content turmeric powder sample (0.5 g) was added in hot 80 percent ethanol to remove sugars, centrifuged and the residue was retained. The residue was then washed repeatedly with hot 80 percent ethanol until the washings did not give colour with anthrone reagent. The residue was dried well over a water bath. Then 5 ml of water and 6.5 ml of 52 percent perchloric acid were added to the residue and extracted at $0^0$C for 20 minutes. Again centrifugation was done and the supernatant was saved. The extraction was repeated using fresh perchloric acid and then centrifuged. The supernatant was cooled and volume made to 100 ml. Thereafter, the supernatant was pipetted out (0.1 or 0.2 ml) and the volume was made up to 1 ml with distilled water. (Sadasivam and Manickam, 14).Protein content in rhizomes was estimated by multiplying the nitrogen content with 6.25 factor. The essential oil content from rhizome was extracted by water distillation with the help of Coking and Middleton apparatus using petroleum ether. The curing percentage was determined as per the procedure adopted by Gopalakrishna *et al.* (4). The mother and finger rhizomes were cured after harvesting. The curing process consisted of boiling the rhizomes in water until frothing occurred with emission of characteristic odour and fingers becoming soft. The cured material was sun-dried for 10-15 days until the rhizomes produced metallic sound. The curing percentage was calculated as below:

$$\text{Curing percentage} = \frac{\text{Cured turmeric yield}}{\text{Raw turmeric yield}} \times 100$$

## RESULTS AND DISCUSSION

The effect of the integrated nutrient management on different quality parameters of turmeric rhizomes is depicted in the Table 1. The quality of turmeric is often valued on the basis of the colour intensity of the rhizome which depends on the presence of curcumin content in the rhizomes. The data in Table 1 revealed that curcumin content in the turmeric rhizome increased linearly and significantly over its lower level with the increasing level of the nutrients either alone or in combination. The highest pooled curcumin content (3.33%) was recorded at treatment combination of 100% NPKS + 20t FYM $ha^{-1}$ as soil mulch with an increase of 32 percent over the control. The superiority of the integrated nutrient over other treatments might be due to improvement in the physical, chemical and microbiological condition of the soil and adequate application of nitrogen, phosphorus

**Table 1.** Effect of integrated nutrient management on various quality components of turmeric rhizomes (Pooled data of *kharif* 2004 and 2005).

| Treatments | Curcumin content (%) | Starch content (%) | Protein content (%) | Oil content (%) | Curing percentage (%) |
|---|---|---|---|---|---|
| Control | 2.58 | 4.93 | 4.21 | 0.92 | 17.01 |
| 20t FYM $ha^{-1}$ (SI) | 2.85 | 5.38 | 4.36 | 1.13 | 18.33 |
| 20t FYM $ha^{-1}$ (SM) | 2.87 | 5.78 | 4.35 | 1.21 | 19.08 |
| 100% NPK $ha^{-1}$ | 3.04 | 6.11 | 4.56 | 1.35 | 19.35 |
| 100% NPKS $ha^{-1}$ | 2.96 | 6.82 | 4.65 | 1.66 | 19.86 |
| 100% NPKS +10t FYM $ha^{-1}$ (SI) | 3.05 | 7.43 | 4.64 | 2.05 | 20.19 |
| 100% NPKS +15t FYM $ha^{-1}$(SI) | 3.16 | 7.76 | 4.90 | 2.40 | 20.59 |
| 100% NPKS +20t FYM $ha^{-1}$(SI) | 3.29 | 8.11 | 4.92 | 2.82 | 21.53 |
| 100% NPKS +10t FYM $ha^{-1}$(SM) | 3.07 | 7.13 | 4.70 | 1.77 | 19.53 |
| 100% NPKS +15t FYM $ha^{-1}$(SM) | 3.18 | 7.62 | 4.79 | 2.38 | 20.41 |
| 100% NPKS + 20t FYM $ha^{-1}$(SM) | 3.31 | 7.89 | 4.83 | 2.85 | 21.19 |
| CD(P=0.05) | 0.08 | 0.24 | 0.09 | 0.17 | 0.46 |

SI: FYM applied as soil incorporation at the time of earthing up; SM: FYM applied as soil mulch at the time of sowing and potassium at the time of sowing and earthing up. Present findings are in close conformity with the observations made by Nandal (12) and Dixit and Bhardwaj (2).

As indicated from the Table 1, starch content was found highest (8.11%) at treatment combination of 100% NPKS + 20t FYM $ha^{-1}$ as soil incorporation with the percent increase of 17 over control. The reason behind these results is that in root crops, synthesis of sizeable amount of starch requires potassium, phosphorus and sulphur. Potassium is required for carbohydrate metabolism, formation and translocation of starch, while phosphorus favours the formation of organic compounds such as phospholipids, nucleic acid and enzymes, which are fundamental for carbohydrate and starch synthesis. Almost parallel results have been reported by Nawale *et al.* (13), Fujimoto *et al.* (3) and Uppal *et al*. (17).

The protein content increased considerably with all the nutrients applied either separately or in amalgamation *viz*. NPK, NPKS at different levels. The maximum mean protein content of 4.92 percent was recorded at 100% NPKS + 20t FYM $ha^{-1}$ as soil incorporation with the percent increase of 16.8 over control (Table 1). This is endorsed to the fact that nitrogen is a main constituent of all the amino acids and sulphur enhances the production of sulphur containing amino acids *viz.,* cysteine, cystine and methionine, which are imperative for protein synthesis. Likewise enhancement of the protein content with integration of nutrients (organics and in-organics) is due to the fact that it can supply higher quantity of N and S, than 100% NPKS alone, which are the chief components for protein synthesis. Such a positive effect of N, P and S fertilizers on the protein content was reported by Chiu *et al.* (1), Nandal (12) and Sharma *et al*. (15).

An appraisal of the data from the Table 1 revealed that highest essential oil content of 2.85 percent was recorded in treatment combination of 100% NPKS + 20t FYM $ha^{-1}$ as soil mulch. The improvement in the oil content is ascribed to the fact that sulphur is main constituent of the oil and its application showed a rising trend for the parameter as compared to other treatments. Similar observations were also made by Krishnamurthy *et al.* (10) and Jadho *et al.* (6).

The data in Table 1 indicated that the highest curing percentage of 21.53 was recorded in the treatment combination of 100% NPKS + 20t FYM $ha^{-1}$ as soil incorporation as compared to 17.01 in the control treatment. Curing percentage is largely influenced by factors such as moisture content and fertility status of the soil. The present results are almost similar to those of Gupta *et al.* (5), Gopalakrishnan *et al.* (4) and Jadho *et al.* (6).

Thus, from the present studies, it was observed that in turmeric, all the quality parameters were found maximum either in the integrated treatment of 100% NPKS + 20t FYM $ha^{-1}$ as soil mulch or 100% NPKS + 20t FYM $ha^{-1}$ as soil incorporation and that too at higher doses of FYM rather than when these treatments were applied alone. It is therefore concluded that in turmeric crop, integrated use of both organic and inorganic fertilizers in right doses should be carried out for harvesting better quality rhizomes.

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