AGROTECHNIQUES FOR THE CULTIVATION OF CURCUMA ZEDOARIA (BERG.) ROSC.

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ABSTRACT: Curcumazedoaria (Berg) Rose. (wild turmeric or kastoorimanjal of commerce rhizome is used as appetizer, tonic, blood purifier and cosmetic. It is useful in flatulence and dyspepsia and also for worms and skin diseases a study on the agrotechniques for its cultivation at the aromatic and Medicinal plants Research Station, Odakkali during 1996-1999 revealed that it is highly adaptable to a wide range of spacings, producing similar yields by adjusting the number of plants/hill. It produces maximum yield of rhizome (34t/ha), essential oil (0.33%) and oleoresin (5.%%) when 1.5 t/ha of seed rhizomes are planted at 60 x40 cm spacing with the receipt of premonsoon showers in May and harvested in January. Application of 20/ha of FYM, 100:50:50 kg N:P:K/ha. Biofertilisers, green manuring and mulching maximize the yields. Combination and interaction effects of the various manorial treatments are to be studied further in detail. The nutrient removal by the crop for the production of rhizomes was 115.96:9.46:111.23 kg NPK/ha.

KEY WORDS: curcuma zedoaria, Kastoorimanjal, spacing, manuring, nutrient removal

INTRODUCTION:

Curcuma. Zedoaria (Berg.) Rosc.syn. C. zerumbet Roxb; Amomum zedoaria Christm. of Zingiberaceae, the Kasthurimanjal of commerce, is also known as Round zedoary in English, Kachura in Sanskrit and Kakhur in Hindi. The round zedoary or zerumat is mostly found in India and S.E. Asia. The plant grows wild in Eastern Himalayas and in moist deciduous forests of coastal tract of Kanara and Kerala. The rhizome of C. zedoaria is used as appetizer and tonic, particularly prescribed to ladies after childbirth. In case of cold, a decoction of long pepper (Piper longum) cinnamon (Cinnamomum verum), zedoary and honey is given. In Ayurveda it is an ingredient of “Braticityadi kwatha”, used in high fever(1). Root is useful in flatulence and dyspepsia, and as a corrector of purgatives. Fresh root checks leucorrhoeal and gonorrhreal discharges. Root powder is a good substitute for many foreign foods for infants. For worms, the juice of the leaves is given in dropsy (2). It is an odoriferous ingredient of the cosmetics used for the cure of chronic skin diseases caused by impure or deranged blood (3). Decoction of fresh rhizomes is used for blood purification. It is used as an ingredient in Chinese medicine for extradurnal haematomas (4). Rhizomes yield sesquiterpenes such as curcumol, curcolone, procureumenol, isocurcumenol, furadiene and its iso-derivative, curcumadiol, dehydrocurdione and zederone (4). Steam distillation of the dried rhizomes yield essential oil containing α – pinene, camphor
and sesquiterphenes (more than 50%). The starch left after the extraction is purified and sold as a commodity of cottage industry in West-Bengal under the name ‘Shoti’ (5). Essential oil from rhizomes contains α – pinene, d-camphene, cineole, d-camphor, sesquiterpenes and sesquiterpene alcohols (6). The novel sesquiterpenoids which have been isolated and characterized are cuzerenone, epi-cuzerenone, iso-furanogermerene, curcumadiol, curcumol, curcumenol, iso-curcumenol, procucumenol, dehydrocurdione (7,8,9); germacrone-4,5-epoxide, germacrene, germacrone furanodienone, curcumenol, iso-curcumenol, curcumanolides A and B and curcumenone (10). Ethyl-p methoxy-cinnamate has been isolated from the alcoholic extract of the plant (11).

In vitro propagation of C.zedoria has been attempted by Anand et al (12). Though the plant is adapted to tropical climate and large scale demand exists for its rhizome no attempt has been made to develop its cultivation technology. This study was taken up to develop agrotechnology for the cultivation of the crop.

MATERIALS AND METHODS

The study was conducted at the Aromatic and Medicinal Plants Research Station (AMPRS), Odakkali for two years during 1996-99. The soil had a pH of 5.50 and was low in N, high in P and medium in K status. The experiment was in randomized block design with 3 replication. The treatments comprised of 20 factorial combinations of 4 spacings and 5 manurai treatments as given below.

i) four spacing (cm):
   20x20, 30x20, 30x30, 40x40

ii) five manurai treatments
   1. Control
   2. FYM, 20t/ha.
   3. N,P2O5 and K2at 100:50:50 Kg/ha.
   4. Green manuring in situ (sowing cowpea at 25 kg/ha, uprooting at flowering and using as mulch 30 days after sowing)
   5. Bilfertilizer: Azospirillum at 10 kg/ha.

Biofertiliser was obtained from M/s. Agrobiotech, Kottayam. Organic manures and biofertilisers were applied as basal. In the case of inorganic fertilizers, P was applied as basal while N and K in two equal splits at planting and two months after planting. The crop was planted with the onset of monsoon in May and harvested in January after the leaves have dried up. The treatments were imposed as per the programme. In cowpea green manuring in situ cowpea seeds were sown at 25kg/ha at planting and the plants were uprooted and used as mulch 30 days after planting. No irrigation was given. growth observations and weed biomass were recorded two months after planting at the time of weeding and topdressing and the yield observations at the time of harvest. Nutrient contents in rhizome and in soil were recorded after harvest; N by Micro Kjeldahl method, P by spectrophotometer and K By Flame photometer.

The plant materials were hydro-distilled for 5 hours in Clevenger’s apparatus for extracting the essential oil. Efforts were made to determine the components of the essential oil using a gas chromatograph (Chemito model 8510) equipped with flame ionization detector. The constituents of the oil were separated on a 10 feet long stainless steel column loaded with 5% SE-30 on 80-100 mesh chromosorb- W at a nitrogen flow rate of 30ml/min. the oven was programmed to heat from the initial temperature of 110C to 2200C at the rate of 30C/min. the
injection and detection temperatures were 2700°C. Attempts were made to identify the peaks based on coincidence of retention times with authentic standards. Quantification was done by area normalisation method. The oleoresin was extracted by solvent extraction method. The data were pooled and statistically analysed.

RESULTS AND DISCUSSION

The results are furnished in tables 1-3 and figures 1-2. Pooled results showed that spacing affected only the number of plants/hill, which increased with increase in spacing. This indicates that the plant is capable of adjusting the plant population per unit area by regulating the sucker production to a great extent. Here a wider spacing of 60x40 cm can be adopted considering the saving in seed rate. With respect to manuring effect, the variation in rhizome and oil yields was maximum of 34.67 t/ha of fresh rhizomes with FYM application, followed by 28.73 t/ha with NPK. The favourable effect of FYM and NPK application was reflected on the plant growth characteristic also. These yields were significantly superior to the control. Application of biofertiliser and cowpea green manuring, though on par with NPK application, were statistically not different from the control. Oil yield under FYM treatment was significantly higher than that under any other treatment. Application of NPK and biofertiliser was superior to control. Cowpea green manuring significantly reduced the oil yield. Oil recovery was not influenced by the treatments. Application of NPK and biofertiliser was superior to control. Cowpea green manuring significantly reduced the oil yield. Oil recovery was not influenced by the treatments competitive effect of cowpea might have reduced the rhizome and oil yield in cowpea green manuring. NPK application significantly reduced oleoresin content of rhizome. It was maximum in the control, followed by cowpea green manuring. Oleoresin yield under FYM treatment was significantly higher than that under any other treatment.

On an average over the treatments, Curcuma grew to a height of 98 cm and produced 2-3 plants/hill and 6 leaves/plant. The yield was 28.24 t/ha fresh rhizomes or 7.89 t/ha of dry rhizomes. Dry weight was 27.98%. Oil recovery was 0.33% on fresh weight basis and 1.05% on dry weight basis. Oil yield was 91.79 l/ha. Oleoresin recovery was 5.49% and Oleoresin yield was 433.11 Kg/ha.

Spacing and manuring also significantly influenced the P and K contents of rhizome (table 10, Figure 12). P content was maximum with FYM application followed by biofertiliser. K content was maximum with the application of biofertiliser Azospirillum at 10 kg/ha in general, organic sources of nutrients had a favourable effect on the nutrient contents in the rhizome. The interaction effects of spacing and manuring treatments on the P and K contents of Curcuma rhizomes were statistically significant. P content in rhizome was highest with FYM application at 30x20 cm spacing whereas K content was highest in the control at 60x40 cm spacing. Application of FYM showed significant build up of soil available P resulting in higher uptake of the nutrient by the plant.

On an average over the treatment for two years, Curcuma dry rhizomes contained 1.47% N, 0.12% P, 1.41% Na at the time of harvest. The nutrient removal by the crop for the production of rhizomes was 115.96:9.46: 111.23 kg NPK/ha. The soil nutrient status was 296.39 kg/ha N, 1001.54
kg/ha P(2)5, 150.15 kg/ha K2 O and 67.92 kg/ha Na2O after the harvest of the crop.

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### TABLE 1
**EFFECT OF SPACING AND MANURIAL TREATMENTS ON THE GROWTH OF CURCUMAZEDOARIA (KASTOORIMANJAL) (POOKEDMEAN OF TWO YEARS)**

| Treatment          | Hills/plot (No.) | Plant Height (cm) | Plants/hill (No.) | Leaves/plant (No.) | Cowpea Biomass (kg/ha) |
|--------------------|------------------|-------------------|-------------------|--------------------|------------------------|
| **1. Spacing (cm)**|                  |                   |                   |                    |                        |
| 30x20              | 56.0             | 96.74             | 1.83              | 6.31               | 4694                   |
| 40x30              | 42.93            | 97.42             | 2.26              | 6.21               | 4380                   |
| 60x40              | 30.43            | 100.86            | 2.36              | 6.37               | 7358                   |
| 60x60              | 23.00            | 97.77             | 2.55              | 6.60               | 5127                   |
| CD(.05)            | 2.674            | NS                | 0.326             | NS                 | NS                     |
| **2. Manuring**    |                  |                   |                   |                    |                        |
| Control            | 38.49            | 91.18             | 2.08              | 6.30               | --                     |
| FYM                | 38.25            | 111.73            | 2.28              | 6.38               | --                     |
| NPK                | 37.79            | 100.08            | 2.51              | 6.43               | --                     |
| GM                 | 37.95            | 94.10             | 2.26              | 6.27               | 5390                   |
| BF                 | 37.98            | 93.90             | 2.12              | 6.50               | --                     |
| CD (.05)           | NS               | 6.750             | NS                | NS                 | --                     |
| Interaction Sp.x Ma. | NS               | NS                | NS                | NS                 | --                     |
### Table -2
**Effect of spacing and manorial treatments on the yield parameters of Crucuma zedoaria (Kastootimanjal ) (Pooled mean of two years)**

| Treatment          | Fresh Rhizome Yield (t/ha) | Dry Rhizome Yield (t/ha) | Oil Yield (1/ha) | Oil Recovery FWB (%) | Oil Recovery DWB(%) | Oleoresin Content (%) | Oleoresin yield (kg/ha) |
|--------------------|-----------------------------|--------------------------|------------------|----------------------|---------------------|-----------------------|-------------------------|
| **1. Spacing (cm)** |                             |                          |                  |                      |                     |                       |                         |
| 30x20              | 28.642                      | 8.003                    | 97.38            | 0.34                 | 1.09                | 5.46                  | 436.96                  |
| 40x30              | 28.844                      | 8.059                    | 92.31            | 0.32                 | 1.03                | 5.69                  | 458.55                  |
| 60x40              | 29.528                      | 8.250                    | 94.49            | 0.32                 | 1.03                | 5.48                  | 452.10                  |
| 60x60              | 25.927                      | 7.244                    | 82.96            | 0.32                 | 1.03                | 5.33                  | 386.11                  |
| CD(.05)            | NS                          | NS                       | NS               | NS                   | NS                  | NS                    | NS                      |
| **2. Manuring**    |                             |                          |                  |                      |                     |                       |                         |
| Control            | 24.874                      | 6.950                    | 84.57            | 0.34                 | 1.09                | 5.99                  | 416.31                  |
| FYM                | 34.666                      | 9.686                    | 110.93           | 0.32                 | 1.03                | 5.43                  | 525.95                  |
| NPK                | 28.728                      | 8.027                    | 94.80            | 0.33                 | 1.06                | 5.18                  | 415.80                  |
| GM                 | 25.728                      | 7.211                    | 77.42            | 0.30                 | 0.96                | 5.61                  | 404.54                  |
| BF                 | 27.101                      | 7.572                    | 92.14            | 0.34                 | 1.09                | 5.24                  | 396.77                  |
| CD (.05)           | 3.3712                      | 0.9419                   | 6.600            | NS                   | NS                  | 0.410                 | 51.805                  |
| Interaction Sp.x Ma. | NS                        | NS                       | NS               | NS                   | NS                  | Sig                   | NS                      |

### Table -3
**Effect of spacing and manorial treatments on the yield parameters of Crucuma zedoaria (Kastootimanjal ) (Pooled mean of two years)**
| Treatment Na₂O        | Nutrient content in rhizome (%) | Nutrient content in soil (kg/ha) |
|----------------------|---------------------------------|----------------------------------|
|                      | N  | P  | K  | Na | N  | P₂O₅| K₂O |
| 1. Spacing (cm)      |    |    |    |    |    |     |     |
| 30x20 63.28          | 1.52 | 0.13 | 1.36 | 0.01 | 268.9 | 112.65 | 141.05 |
| 40x30 71.02          | 1.48 | 0.12 | 1.27 | 0.01 | 271.0 | 99.07 | 161.33 |
| 60x40 64.80          | 1.44 | 0.13 | 1.65 | 0.01 | 278.0 | 94.40 | 151.49 |
| 60x60 72.58          | 1.43 | 0.12 | 1.35 | 0.01 | 259.6 | 100.05 | 146.75 |
| CD (.05) NS          | NS | 0.010 | 0.10 | NS | NS | 10.03 | NS |
| 2. Manuring          |    |    |    |    |    |     |     |
| CONTROL 64.76        | 1.42 | 0.12 | 1.47 | 0.01 | 276.4 | 88.79 | 139.92 |
| FYM 73.85            | 1.45 | 0.14 | 1.43 | 0.01 | 267.4 | 154.21 | 140.64 |
| NPK 66.14            | 1.47 | 0.11 | 1.22 | 0.01 | 271.5 | 89.30 | 170.53 |
| GM 70.45             | 1.48 | 0.12 | 1.43 | 0.01 | 277.8 | 88.92 | 159.91 |
| BF 64.40             | 1.52 | 0.13 | 1.49 | 0.01 | 253.9 | 86.49 | 139.77 |
| CD (.05) NS          | NS | 0.01 | 0.110 | NS | NS | 11.21 | 22.61 |
| Interaction Sp.x Ma. | NS | Sig | Sig | NS | NS | NS | NS | NS |
Fig. 1: Effect of spacing and manural treatments on rhizome and oil yields of *Curcuma zedoaria*.

Fig. 2: Effect of spacing and manuring treatments on sucker production of *Curcuma zedoaria* as against the planted population.