

Manuring of the Coconut Crop

By

G. V. NARAYANA. B. sc. (Ag.)

Oilseeds Specialist, Agricultural Research Institute, Coimbatore

Introduction: The coconut is an important crop, particularly in Madras where there is an area of about 6.2 lakhs of acres producing about 1,500 million nuts and accounting for 41% of the acreage and 46% of the production in India. On the West-Coast where 69% of the area under coconut in this State is concentrated, the crop is of considerable economic importance. The present production in India which is estimated at 3,300 million nuts falls short of the requirements of the country by about 50%. This naturally results in abnormal rise in prices and necessitates importing coconut products from foreign countries. There is, therefore urgent need to step up production. This can be done by two ways: (1) by extending the existing area under the crop, and (2) by increasing production of the existing area. The first is a long-range method; and the production from the existing area can be stepped up by adopting proper manuring and cultivation. This paper deals with this aspect of the subject.

Object of Manuring: Manure is food for the crop and manuring serves two purposes: (1) to replenish the manurial ingredients of the soil which have been removed by the crop and (2) to maintain the crop in a normal condition so as to ensure proper yields. The manure to be applied naturally consists of such ingredients as are required for the purpose mentioned. These, broadly speaking, are (1) nitrogen, (2) potash and (3) phosphoric acid. In addition to these three main ingredients a number of other elements are required to keep the plant in healthy and proper condition. It is presumed that secondary elements are found in the required quantity in the soil and are, therefore not ordinarily added to the manure that is given to the crop. However, to give the plant or the crop a complete food it is necessary to analyse the soil and find out exactly the constituents of the soil and see whether they are present in the required quantity and in an available form sufficient for the growth of the crop. If not such want has got to be made good.

Manurial Requirements of the Coconut: The work done on the manurial requirements of the coconut in this State has been mostly confined to the Coconut Research Station, Kasaragod, South Kanara district. The soil is a deep sandy loam with the following analysis:—

Loss on ignition	2.25
Available P_2O_5	0.001
Available K_2O	0.002
Lime	Trace
Magnesia	0.07

A regular bearing coconut garden yielding about 2,000 nuts per acre, per year has been found to require about 24 lb. of nitrogen, 12 lb. phosphoric acid and 60 lb. of potash. These figures include the quantities required to build up the trunk, to form the leaves and flowering bunches

and also the nuts. These figures are much less than those given for Malaya and Philippines. Therefore, it goes without saying that these ingredients have to be given back to the soil so as to maintain its normal fertility.

Coconut is a perennial crop, producing nuts practically throughout its life time from the time of commencement of the first flowering. Every month a bunch of nuts is produced. Therefore, the manurial ingredients from the soils are being regularly and constantly removed and it is necessary that manuring has to be done regularly every year if not every month. The effect of manuring in the coconut as expressed in terms of yield of mature nuts is perceptible only in a period of about 3 years from the commencement of manuring because, the time taken from the formation of the primordia of the flowering bunch till the time of harvest is about three years. And this process of formation goes on practically throughout its life under normal conditions. Therefore, it is obvious that the necessary supply of plant food should be available to the plant all through its life-time. The main ingredients of the coconut manure consist of three major elements namely, nitrogen, phosphoric acid and potash. To find out the quantity that should be applied, a well-laid out experiment consisting of N, K₂O and P₂O₅ singly and in combination and if possible at different levels is necessary to arrive at a clear indication of the requirements of the crop. The response of the crop to the treatments given as expressed in terms of yield has to be considered. Some experiments in this direction have been carried out at the Coconut Research Station, Kasaragod. The first set of manurial experiments was started in 1922—1923 and continued till 1931—1932. Nitrogen in the form of ammonium sulphate and fish guano, potash in the form of potassium sulphate and ash, and phosphoric acid in the form of super-phosphate were given. Also cattle manure, salt and lime were tried singly and in combination. In this experiment, the maximum response was obtained with ammonium sulphate 3 lb. and 20 lb. of wood-ash per tree per year. The next best was cattle manure at the rate of 100 lb. per tree, per year. Significant increase in the yield viz., 14.5% was obtained in the case of low-yielding palms (below 30 nuts per year) and also medium bearers (27% increase) but not in the high-yielding ones, giving 80 or more nuts per tree, per year. It must be noted in this connection that though the high-yielding palms have not given increased yield consequent on manuring, it goes without saying that they also should be manured to maintain soil fertility and the normal production of nuts. Otherwise, the soils will soon be deprived of the manurial ingredients and the yield would naturally go down in due course. In this connection it may be stated that ammonium sulphate alone did not give as much marked response as ammonium sulphate and ash. Salt and lime did not give any significant increase of yield. Based on the indications obtained in the previous experiment, a new series of experiments were laid out in 1932 with ammonium sulphate and ash and cattle manure applied broadcast and in basins (6' radius 1' deep.) It was conclusively proved that ammonium sulphate 3 lb. and ash 20 lb. gave the highest yields and that broadcasting of the manure was better than applying it in basins. The experiment was further elaborated in 1937—1938 to find out whether a higher dose of 4½ lb. of ammonium sulphate would give better results than 3 lb. and also whether it could be substituted with groundnut cake, and ash with potassium

sulphate. It was found that increased dose of ammonium sulphate, namely $4\frac{1}{2}$ lb. per tree, per year gave higher yields than 3 lb. of it per tree, per year. It was also found that ammonium sulphate can be replaced by groundnut cake on equivalent nitrogen basis and ash can be replaced by potassium sulphate on equivalent potash basis. It may be stated that no significant response was obtained consequent on the application of P_2O_5 . The soil contained only 0.35 of total and .001 of available P_2O_5 . Perhaps this quantity though small meets the normal requirements of the crop. Still, as large quantities (12—40 lb.) are being annually removed by the crop, it is necessary to add P_2O_5 in some form or other as superphosphate or as bonemeal. As the soils are acidic in reaction and as coconut is said to thrive better under a slightly alkaline medium, it is desirable to add some lime also to the soil. The ash applied which contains about 22% of CaO, is considered to be helpful in this respect.

Organic matter and green manuring: The Kasaragod soils were poor in organic matter, the loss on ignition being only 2.25%. Therefore, to augment the supply of organic matter it is necessary to add it in the form of farmyard manure, compost or green-leaf, or as oil-cakes. Farm yard manure is available only in very limited quantities and is required for other crops. Oil-cakes are in short supply. The best and cheapest form of organic matter appears to be a green manure crop grown in the field and ploughed in. All the known green manure crops that are likely to be of use for coconut plantations have been tried and the best is the wild sunhemp or *Crotalaria striata*. This leguminous plant has at times given as much as 20,000 to 30,000 lb. of green stuff per acre and it comes up very well under the shade of coconut trees. In this connection it should be mentioned that it is desirable to return to the soil as much as possible of coconut by-products other than those required by man. For example all the dried leaves, husks and all the refuse usually found in a coconut garden which contain valuable manurial ingredients should be buried in the field in trenches, or the ash obtained by burning them should be given back to the soil. Where the green husks are utilised in the manufacture of coir, they cannot be used as manure. But dried husks prove very valuable to the soil. In an experiment conducted at the Kasaragod station for a period of 7 or 8 years it was found that burying of coconut husks at the rate of 1,000 husks per tree with all the dried leaves and refuse obtained in the garden was found to benefit it and increase the yield to a marked extent (70%). The effect of burying the husks and leaves once, lasted for about 5 years without the addition of any other manure. The field received, however, regular cultivation and a crop of green manure was grown in the field and ploughed in and incorporated in the soil. This practice of burying husk is of considerable value particularly in rain-fed gardens.

Importance of ash: In the manuring of the coconut gardens, special attention should be paid to the application of potash. It is perhaps more important than even nitrogen itself, because potash is the main ingredient in the various parts of the palm, particularly the leaves (4% K₂O), husks (1%) and kernel (4%). From the manurial experiments conducted, it was found that even the application of ash alone at the rate of 20 lb. per tree, per year) gave highly significant increase in yield of about 34 nuts more than the control plot without ash. In one of the manurial

experiments mentioned in the previous para, it is stated that ash, which is not available in the required quantity can be replaced by potassium sulphate. Though the yield is not affected by this substitution, it must be stated that ash is a better manure for the coconut in the long run than potassium sulphate, because potassium sulphate contains only K_2O while ash contains other ingredients also, besides K_2O and CaO . Therefore, it is worthwhile finding out an artificial product approaching the ordinary ash in analysis and containing all the ingredients.

Precautions in applying ammonium sulphate, ash and cattle manure: Ammonium sulphate applied alone without ash did not give significant increase in yields. It is very important, therefore that ammonium sulphate should always be applied with ash. However, it should be borne in mind that ammonium sulphate is acidic and ash is alkaline in reaction and the two manures should not be mixed up and applied. They should be applied separately at an interval of fortnight or a month. Cattle manure at the rate of 100 lb. per tree, per year gave a significant increase in yield coming next in rank to ammonium sulphate and ash. But cattle manure cannot be had on a large scale and in sufficient quantities and its use can only be very limited. Also in places where cattle manure is applied, there is the danger of the soil breeding the rhinoceros beetle which is a bad pest of the coconut.

Time and method of application: Manures should be applied only when there is sufficient moisture in the soil, though not too much of it. The best time to apply the manures under the West Coast conditions is some time in September. Incompatibles like acid and alkali manures should not be mixed.

The method of applying manure is an important consideration. As feeding roots of the coconut are found all over the field, it is considered necessary to apply the manures broadcast all over the field. The feeding roots go to a depth of some 3 or 4 feet below the ground level and it is desirable to put in the manure as deep into the soil as possible. For this purpose the soil should be ploughed deep so as to incorporate the manures in the deeper layers of the soil. In an experiment conducted on the method of application of manures it was found that application by broadcasting gave better yields than applying them in basins dug near the bases of the trees. However, in the case of young seedlings or palms where the root system has not spread throughout the field, the manures may be applied near the palms, extending to a radius of about 5' or 8' all round. The dose of the manure to be applied to the young palms till they come to the bearing stage is about half the dose of the adult trees.

Effect of manuring on the produce: It has already been stated that the yield of nuts particularly of low bearers, increases considerably as a result of manuring. It has effect on the quality of crops also, which contain more of N and P_2O_5 . Palms receiving complete manure (viz. N, P, and K), cattle manure and green manure, had higher copra content per nut, and in the case of palms receiving ammonium sulphate the percentage of oil also increased.

Manuring and disease: A coconut garden which is regularly cultivated and manured is able to withstand the vagaries of the season better than a neglected garden. In times of severe drought and other

adverse conditions, properly maintained gardens do not suffer to the same extent as the neglected ones. Where the trees are weak due to neglect they suffer more, consequent on the incidence of pests and disease than robust healthy trees. In the trials conducted at the Coconut Research Station, Pilicode, where 'shoot rot' disease is prevalent it was found that a regular application of potassium sulphate warded off the disease to a marked extent.

Manuring and Cultivation: In the coconut, manuring goes hand-in-hand with cultivation of the soil. In an experiment designed to find out the effect of cultivation alone and manuring alone it was found that there was significant increase in the yield of plots receiving regular cultivation alone without manuring (166% over the unmanured and uncultivated plot), while the plots receiving manuring alone (5 lb. of fish guano, 40 lb. of ash and 40 lb. of greenleaves per tree) without cultivation did not give significant increase in yield. It is therefore, evident that cultivation by itself is more important than manuring alone without cultivation. In normal practice it is necessary that manuring should be practised along with regular cultivation of the soil. Cultivation by ploughing not only keeps down the growth of weeds but also gives a root pruning at the surface of the soil and helps to keep the roots below the ground level which is considered beneficial for the coconut. Also regular cultivation aerates the soil and also enables the rain water to soak into the soil.

Schedule of manuring: The following schedule of manuring will be found to be the best and most suitable for coconut gardens in the West Coast under rain-fed conditions. Plough the land in February-March with a mouldboard plough so as to create soil mulch and receive the summer rains. In May, when there is sufficient rainfall, sow a green manure crop, like *Crotalaria striata*, at the rate of about 20 lb. per acre and cover with a light plough or a cultivator like the Junior Hoe. In September-October, after the cessation of the South-West monsoon rains broadcast ammonium sulphate and bonemeal at the rate of $4\frac{1}{2}$ lb. of the former and 2 lb. of the latter. Plough in the manures applied and also the green manure crop by means of a heavy iron plough. If the green manure crop cannot be ploughed into the soil it is to be cut and buried in shallow trenches between rows of trees, the position of trenches being shifted every year. Then in November-December broadcast wood-ash at the rate of 30 lb. per tree and work a light plough or cultivator so as to incorporate the manure into the soil and also to put down the growth of weeds.

Ammonium sulphate can be replaced by groundnut cake or other oil cakes on equivalent nitrogen basis. While ammonium sulphate contains about 20% of N, groundnut cake contains about 8% of N. Ash can be replaced with potassium sulphate on equivalent potash basis. Ash contains 3% of potash and potassium sulphate contain 43%. Among the phosphatic manures bonemeal contains about 16% of P_2O_5 and superphosphate ordinary 22%. If it is not possible to grow a crop of green manure in the field green leaves (1% of N) at the rate of about 50 lb. per tree may be applied. The schedule given in the foregoing is a complete scheme of manuring and cultivation which not only maintains the soil at a high level of fertility but also ensures regular and increased yield of the trees. As has already been explained it is important that these operations

are carried out regularly every year. If it is not possible to give nitrogenous and other manures, attempts should be made to supply every year at least ash or potassic manures. If even this is not possible a green manure crop may be regularly grown and ploughed into the soil. If, however, even the green manure crop cannot be grown or green leaves applied, the soils should be regularly ploughed and cultivated once or twice in a year.

In addition to manuring and cultivation it is very necessary that the garden is protected from pests and diseases by taking prompt action and adopting remedial measures in time. Regular and systematic search for the rhinoceros beetle in the crowns of palms should be made and the beetles killed. It may be pointed out that neglect in this respect is usually responsible for a loss of about 10% or more of the yield.

Economics of manuring: After all, agriculture as a business proposition should pay. Intercultivation and manuring of the coconut as indicated in the foregoing can easily increase the yield considerably. The increase in yield should cover the cost of manuring and cultivation and leave a reasonable margin. The major manures to be used and the quantity to be applied depends on the availability of manures and their prevailing market prices. Taking the price of ammonium sulphate at about as 2½ per pound and ash at about Rs. 2 per 100 lb. and bone meal at as 2 per pound, the schedule of manuring and cultural operations mentioned cost about Rs. 2—8—0 per tree at per year. And the yield is put at an average of about 50 nuts per tree, per year, valued at Rs. 10/-, which leaves a net profit of about Rs. 7—8—0 per bearing tree, or about Rs. 470/- per acre. In a neglected garden taking the yield at about 20 nuts per tree, per year, the net profit due to manuring, per tree, is about Rs. 3—8—0 per year. At the present high prices for coconut, manuring and cultivation certainly do pay. But it should be remembered that the garden should be always looked after and cared for, irrespective of the market price of the coconuts. The system of manuring and cultivation advocated in this paper pertains mostly to the West Coast rain-fed conditions and cannot be said to be applicable in full to the other coconut tracts of the State. To get at the correct data of manuring, a regular experiment should be conducted in the tract concerned for a series of years and then alone can the findings be advocated with confidence.

Summary

The coconut is an important oil seed crop of the Madras State with an area of 6.2 lakhs of acres, mostly in the West Coast. Still the production is only 50% of the demand and has to be stepped up. This can be done by manuring. The crop yields nuts throughout the year and practically throughout its life-time from the time of commencement of first fruiting. Considerable quantities of plant food are being continually removed by the palm to build up its body and produce nuts. Therefore complete manuring has to be done regularly every year so as to replenish the soil with the ingredients removed, and maintain the palms in good condition and high productivity. As a result of a series of experiments conducted at the Coconut Research Station, Kasaragod, it has been found that the best manure for the coconut is 4½ lb. of ammonium sulphate or 15 lb. of groundnut cake, 30 lb. of superphosphate, in addition to a crop of green manure (*Crotalaria striata*) grown in the coconut garden and

incorporated into the soil. The most important ingredient is potash contained in ash. Manuring goes hand in hand with regular cultivation. Even if the soil cannot be manured it should be regularly cultivated. A schedule of manuring for the West Coast rain-fed gardens is given. It is very desirable that all unwanted dry leaves, spathes, dry husks and other refuse which contain valuable manurial ingredients are buried in the garden.

The effect of manuring on the yield is perceived in a period of two to three years after the commencement of the operations. Low yielders (below 30 nuts per tree per year) respond best to manuring with an increased yield of even 65%, and the medium yielders can give 27% increase. But the heavy yielders giving about 80 nuts per tree cannot further increase their yields. Still they should be manured regularly to maintain the yields. Manuring improves the quality of produce also. At a modest estimate a regularly cultivated and manured garden can give a net profit of Rs. 470/- per acre at the prevailing market rates.

The schedule of manuring given here is not quite applicable to all the different coconut tracts of the State, and experiments have to be conducted in each tract before recommending the best manure suitable for the tract.

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