CO-ORDINATED RESEARCH ON BLACK PEPPER

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INTRODUCTION

Black pepper or the "golden vine" is the most important of all the 50 odd spices grown in India and contributes to about 71% of our total foreign exchange earnings (1988-89), touching an export figure of 41,065 MT. It is grown in 1.51 lakh ha (approx.) of land, largely distributed in Kerala (94%), Karnataka (5%), Tamil Nadu, Andhra Pradesh and the North Eastern States especially Assam. This spice is also quite important in the international trade, accounting for about 36.5% of the world trade in Spices. The world demand projections of this spice for 1995 AD and 2000 AD have been put at 1.62 lakh & 1.85 lakh MT respectively. Specialised agencies like the International Pepper Community (IPC) and the "Peppertech" regulate the production, supply and demand of this important spice which is an unique feature among all the spices in the international market.

India, during early 30s and 40s used to be the chief producer and exporter of pepper, accounting for about 80% of the world production; but this aura of pre-eminence slowly drifted from us when Brazil Malaysia, Indonesia and Sri Lanka took up to cultivation of this spice and realisation of greater yields per unit area. India, albeit being the house of black pepper had traditionally poor yields, of the average of say, 200 to 250 g dry pepper per vine per year. Ironically, the origin of pepper is stated to be the Western ghats and even today, this spice remains to be a homestead crop throughout the 600 Km belt of Kerala and the average pepper holding in Kerala being a mere 1.73 ha (1978), although large plantations have come into being in the Corporate sector, both in Andhra Pradesh and Kerala.

BLACK PEPPER RESEARCH

The first-ever organised research set up on spices initiated with the ICAR Scheme on Pepper research at Panniyur in 1949 under the Govt. of Madras. Later, the activity spread to Thodupuzha, Kerala (1957), Dergaon, Assam (1956), Sirsi, Karnataka (1961), Pottangi, Orissa (1961) besides a Regional Research Centre at Chethalli (Karnataka) and on quality aspects at the Central Food Technological Research Institute (CSIR) at Mysore. The above programmes were envisaged to alleviate the sufferings/decline of the pepper industry in South India, due to poor cultivation and production from this spice. The ICAR instituted the All India Spices & Cashewnut Improvements Project (AICSCIP) in 1971 with its headquarters at CPCRI, Kasaragod. The objectives of this Coordinated Research Project were:

(i) To evolve high yielding varieties resistant/tolerant to diseases and pests,

(ii) To standardise agrotechniques for the crops under different agroclimatic conditions,

(iii) To evolve control measures for major pests and diseases, and

(iv) To work as an inter-face and feed back between the Agricultural Universities and the Central Plantation Crops Research Institute/National Research Centre for Spices and ICAR.

Research schemes were formulated during the IV Plan at Panniyur (1971) and the VI Plan at Sirsi (1981) and Chintapalli (1981), thereby fulfilling the research needs in the traditional and non-conventional areas/agroclimatic zones which deserved research support. Nevertheless, a Regional Station of the CPCRI was also started at Calicut (1975) exclusively devoted to Spices. The major programmes of research under the Coordinated net work are:

(i) Germplasm collection, description & evaluation;

(ii) Intervarietal hybridisation to evolve high yielding varieties;

(iii) Comparative yield trail of selected cultivars;

(iv) Irrigation cum NPK fertiliser trial;

(v) Control of pollu disease; and

(vi) Investigation on quick wilt and slow wilt disease of pepper, including field testing of systemic fungicides.

These programmes are carried out at the Pepper Research Station, Panniyur under the Kerala Agricultural University, Agricultural Research Station (Pepper), Sirsi under the University of Agricultural Sciences, Dharwad, Karnataka and the Regional Agricultural Research Station, Chintapalli under the Andhra Pradesh Agricultural University. The salient findings from the research base at these Coordinating Centres (mostly contributed from Panniyur) can be enumerated as below:

1. Crop improvement

1.1. **Germplasm collection :** One major activity has been to assemble the world germplasm on pepper and intensive surveys have been undertaken to achieve this goal. The Panniyur centre has 63 cultivars, 117 wild types and a host of over 7000 cross combinations, OP seedlings, hybrid progenies etc. Availability of this adequate variability has helped carrying out hybridisation/breeding programmes and exploitation of the progenies etc. Promising cultures like 54, 120, 141, 211, 239, 331, 406, 774, 1310 etc. are under evaluation and pre-release testing.

A significant finding has been the path coefficient analysis of the yield components which lead to positive and significant correlation with the number of spikes, length of spikes, number of developed berries per spike etc. By raising the progeny seedlings from the hybrids and open pollinated seedlings, over 50 cultures with high yield potential have been located. Eleven of these are under comparative yield trial and multilocation trials which would form the base for the varietial scenario of the future.

1.2. **Wild germplasm :** Variability in pepper germplasm is an important asset for future crop improvement programmes. This variabilty is available in the Western Ghats, Himalayan region of Assam and the Eastern India; besides some species from Brazil offer resistance to diseases. The Panniyur centre has assembled *Piper longum, P. attenuatum, P. colubrinum* and *P. hymenophyllum*. Additional species like *P. obliquum, P. quineens* etc. are also added to increase the variability. It has been stated that the types from Assam have high piperine with less moisture and be of better quality.

1.3. **Survey :** Systematic attempts have been made by the Panniyur centre to intensively survey the Western Ghats, in collaboration with the National Bureau of Plant Genetic Resources (NBPGR), Regional Station at Trichur and the University of Agricultural Sciences, Dharwad. Similarly the Chintapalli centre also had made survey of the forests in the Agency tracts to locate new types/accessions in black pepper and related species. The current holding of germplasm in the three centres are Panniyur—206, Sirsi—75, and Chintapalli—28 accessions.

1.4. **Varieties :** Over 60 cultivars are being grown in different pepper growing tracts, although a specific chart has been made available to indicate the specific cultivars *vis-a-vis*, area suited. The first hybrid "Panniyur-1" was released from the Pepper Research Station, Panniyur in 1962 which gives an average yield of 2.2 kg dry pepper per vine per year. It is a cross between Balancotta × Cheriyakanniakadan one being a Malabar type and the second belonging to Travancore region. This variety, although sensitive to shade, is highly adaptable; it responds well to fertiliser application and more specifically to higher N doses.

Recently (in 1989), two more cultures have been recommended for release from the Panniyur centre as detailed below:

(i) *Culture No.* 141 (*Krishna*)

Suitable for all Pepper growing tracts; OP line from cultivar Balancotta; average yield—4.94 kg green berries/vine; dry recovery : 35.7% oleoresin : 10.89%.

(ii) *Culture No.* 331 (*Shyma*)

Suitable for all pepper growing tracts; hybrid between Uthirankotta × Cheriyakaniakadan; average yield—4.88 kg/vine; dry recovery — 27.8%; oleoresin — 12.6%.

The Sirsi and Chintapalli centres are yet to come out with specific varieties which would suit their zones better; but at present, cultivars Uddaghere, Doddige and Malligessera (Kari & Billi) are quite popular in Karnataka tracts in Uttara Kannada, Dakshina Kannada and Kodagu districts. In the eastcost, the ruling variety is still Panniyur-1 besides some pockets with Karimunda. Comparative yield trials to test popular cultivars are underway (since 1987) in these centres to identify superior types.

1.5. **Yield stability** : Studies on yield stability conducted at Panniyur have shown that the Kuthiravaly Type II is the most stable among the cultivars. It has also been worked out that there will be a general yield decline after 15-20 years for any pepper cultivar and studies at Panniyur centre have shown that replanting of Karimunda & Kottanadan types after 18 years, Balancotta after 15 years, Narayakodi after 22 years and Kuthiravally after 25 years will be advantageous and realise full yield potential.

2. Crop Production

2.1. **Planting material :** Production and distribution of high quality rooted cuttings would constitute an important step in increasing productivity besides enabling a very high percentage of "crop stand". Propagation is achieved by rooted cuttings made from the flowering branches or laterals and also the runner shoots. Studies at Panniyur have shown that the middle 1/3rd portion of the runner shoot provided the best material for seedling production. It was also found that the cuttings when dipped in IBA 1000 ppm for 45 seconds before planting enabled quicker and better roof initiation and further development of the root system. Dusting of cut ends of the "prospective rooted cutting" with "Seradix B_2", a hormone, also induced early root formation. At the Panniyur station, a technique for rapid multiplication of pepper has been developed, although this technique has been more ideally and better demonstrated at the National Research Centre for Spices. Shade regulation studies in Pepper nurseries have shown that when there will be lesser shade, the disease incidence also would be less. A novel technique of propagation viz., "Bush pepper" was also developed at the Panniyur centre using the laterals.

2.2. **Standard, mulching and intercropping :** Black pepper vines are trailed on trees like arecanut or coconut when grown as a mixed crop; it is also grown on trees like mango, jack etc. Among the other live standards tested, *Garuga pinnata* and *Erythrina indica* are quite ideal although leguminous standards could fix Nitrogen and thereby help reduce the demand on artificial fertilisers. At Chintapalli, *Grewia* spp. (Silver oak) is proving to be an ideal standard and the main advantage being its non-deciduous nature which offers sufficient shade in the summer months. Shade regulation is very important in pepper gardens and lopping of limbs and some branches could ensure optimum shade; this is done generally in April i.e., before the onset of the SW monsoon showers.

Mulching the basins during summer months protect the plants from drying up and consequently the yield gets increased as revealed by studies at the Panniyur centre. The common mulches recommended are saw dust, dry leaves and arecanut husk. Digging the soil, done twice a year was optimum to maintain the health and yield of pepper vines. Although many crops are grown as intercrops, the elephant foot yam, turmeric, colocasia and ginger were found to be more advantageous; still, ginger was the most economic intercrop giving maximum returns.

2.3. **Irrigation :** Black pepper is grown as a rainfed crop and in a normal year having about 350 cm rainfall, the crop gives an optimum yield; whenever drought situation prevails especially during December to March, supplementary irrigation would be beneficial. The experiments conducted at Panniyur have indicated that irrigating the vines once in 8 to 10 days, providing 100 litres of water per basin would maintain a 1W/CPE ratio of 0.25 and that suffices the water requirements until the monsoon showers are received by the following May. However, further intensive studies are required to assess the water requirements during flowering and bearing stages. A comprehensive irrigation cum fertiliser trial has been recently laid out at Panniyur and Sirsi centres (1987/88) to work out the optimum irrigation requirements.

2.4. **Nutrition** : It has been generally conceived that pepper responds well to nitrogen application; but higher doses of nitrogen encourages luxuriant vegetative growth with decreased yields, especially with the released variety viz., Panniyur-1. Studies at the Panniyur centre have indicated that a fertiliser dose of 50 : 50 : 150 g NPK respectively per vine per year would be necessary; however, a slightly higher dose of 60 g N per vine has been recommended for north Kerala soils, but any further increase in N does not give corresponding increase in yield. A recent finding is that the K dose can be increased up to 200 g per vine per year. The P dose can be reduced to 25 g or increased up to 100 g based on the P status of the soil. It has been established through radiotracer studies that the effective distribution of roots is over a radial distance of 30 cm away from the base of the vine and up to a depth of 10 cm and this will be the active zone of nutrition. Panniyur centre has shown that application of K @ 150 g/vine/year reduces the percentage of spike shedding. It has also been proved that spraying of NAA or 2, 4-D @ 10 ppm at spike initiation stage, resulted in better spike initiation, better berry setting, better berry development, all resulting in bold and heavy berries; the NAA spray has also resulted in increase in size and weight of berries.

3. Crop Protection

Black pepper production is seriously affected by incidence of various pests and diseases, both in the nurseries and adult vines. Systematic research has been initiated at the Panniyur, Sirsi and Chintapalli centres in this direction.

3.1. **Nursery diseases :** Leaf spot and root rot are the two major diseases in the nurseries and the experiments conducted at Panniyur have shown that spraying and drenching with 1% Bordeaux mixture or 1% Difolatan done at fortnightly intervals effectively controlled the diseases. Lesser shade in the nurseries helped reduce incidence/intensity of these diseases.

3.2. **Spike shedding :** This has been noticed to vary widely in different varieties especially when there will be a high percentage of unisexual flowers, high intensity of shade and also due to the "fungal pollu". The studies at Panniyur centre have shown that the losses due to berry infection by fungal pollu can be 18.87% and the subsequent loss due to "thread infection" at 36.79%. Spraying of vines with 1% Bordeaux mixture in the last week of June and/or August—as found necessary—was effective in controlling the fungal pollu. As indicated elsewhere, application of K @ 150 g/vine/year has also reduced the percentage of shedding.

3.3. **Phytophthora foot rot disease :** Popularly known as 'Quick wilt', this disease has taken a heavy toll of pepper in the Malabar region of Kerala and systematic surveys conducted by the Panniyur centre reveal that the disease incidence could be as high as 22%. At the Sirsi and Chintapalli centres also, survey was taken upto assess the severity of the wilt disease; it was observed that in the areca-pepper mixed cropping system in Karnataka the disease is quite severe. It has been revealed that a positive, significant correlation existed between the weekly incidence of the disease and relative humidity, rainfall and the number of rainy days; a combination of temperatures lower than 23°C and relative humidity greater than 95% induces foot rot incidence. The work done at the Panniyur centre has made possible to develop a multiple linear regression equation using different combinations of weather variables and work out a good model for prediction of the "foot rot disease".

It has been observed at the Panniyur centre that a wild species *P. colubrinum*, a native of Brazil possesses tolerance to *Phytophthora* and this character is being exploited in the breeding programmes. Wilt sick plots have been developed at the Sirsi centre to

evaluate the *Phytophthora* tolerant cultivars and locate desirable material to suit Sirsi conditions.

At present, the results from chemical (field) control trial for the foot rot disease at Panniyur conducted at hot spot areas of Eramum and Padiyotchal have revealed that spraying with 1% Bordeaux mixture done twice or thrice, the first one during May-June ie., with the onset of the SW monsoon, the second during July-August and the third (if necessary) during September-October, coupled with drenching 1% Bordeaux mixture around the base of the vines and pasting 10% Bordeaux paste in the collar or foot region. The Panniyur Centre has also recommended the use of a 'sticker' like Rosin washing soda mixture for cheap and effective dispersal of the BM spray solution. At Sirsi centre also, the same recommendations apply for control of the foot rot disease, although the field trials are still underway to determine better and newer fungicide for disease control. A survey for prevalence of this disease taken up at the Chintapalli centre reveals that the same is not so serious at present, but gains importance with intensive cultivation and movement of seedlings from far away places to the new areas for fresh plantings.

3.4. **Slow decline** : Originally known as "slow wilt", this disease is common in Kerala and Karnataka especially when there will be moisture stress. Although the role of nematodes (especially *Radopholus similis*) has been established as the casual agent in other locations, systematic work has not yet been taken up on etiological aspects in the Coordinating centres. However, studies at Panniyur have revealed that application of 25g Dasanit 5% granules (Fensulphothion) per plant at the root zone along with drenching with 0.1% methoxy ethyl mercuric chloride (@ 4 litres per plant) twice a year before the SW monsoon and by the end of the NE monsoon could check the progress of the slow wilt.

3.5 **Insect pests** : The important pests affecting the pepper crop are the pollu beetle, the leaf-gall thrips, the topshoot borer, the scales & mealy bugs etc. As there has not been a provision of Entomologists at the Pepper Centres of the Coordinated Project, no work has been reported. However, based on the work done at other agencies like the NRCS, TNAU, KAU, etc. specific control measures are available.

4. Epilogue

It has thus been possible to bring out the tangible research results from the Coordinating centres on black pepper research since 1971, but the tempo is yet to pick up in our new centres located at Karnataka and Andhra Pradesh. It must be acknowledged that the National Research Centre for Spices at Calicut has been rendering a helping hand to enable better functioning of these centres. The research results that emanate from the NRCS finds a place elsewhere in this special issue and coupled with that, it shall be the joint endeavour of the Research & Development staff to work out and implement an effective strategy for transfer of technologies in black pepper and help raise our national productivity of this spice from the current level of say 250g per vine per year to at least 1.5 Kg level; still a large yield gap remains between the national average and the attainable yield of 2.4 Kg in Research Stations.