Criteria for identification of coconut palms *in situ* tolerant to abiotic stresses in farmers' fields

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Continuous selection and multiplication of high yielding *in situ* stress tolerant palms will ultimately result in overall improvement of productivity in coconut areas prone to stresses like drought, low temperature, etc.

Coconut palm in a drought affected garden

Coconut palms grown in farmers' field faces several natural stresses even under well managed conditions. However they overcome stress due to timely management. On the other hand, palms in neglected gardens face the stress conditions without any protective or recovery management. Even under these conditions, some palms perform consistently better. These palms possess the inherent capacity to withstand the natural stresses. Obviously, such palms possess the rich gene pool for stress tolerance. Hence this forms the basis for selection of *in situ* tolerant palms for the abiotic stresses like drought, low temperature, salinity, etc.

Continuous selection and multiplication of high yielding *in situ* stress tolerant palms will ultimately result in overall improvement of productivity in coconut areas prone to stresses like drought, low temperature, etc. This can be explained as per Fig 1. The number of palms with low and moderate yield consists almost 60 per cent of the surveyed population in stress. However, the frequency of high yielding and very high yielding palms is less than 15 per cent. Studies indicated that these palms are not only having the high yielding capacity but also have drought tolerance characters (Naresh Kumar *et al.,* 2002). These palms can be termed as *in situ* drought tolerant palms as the analysis of past weather of those locations indicated that these palms have faced at least

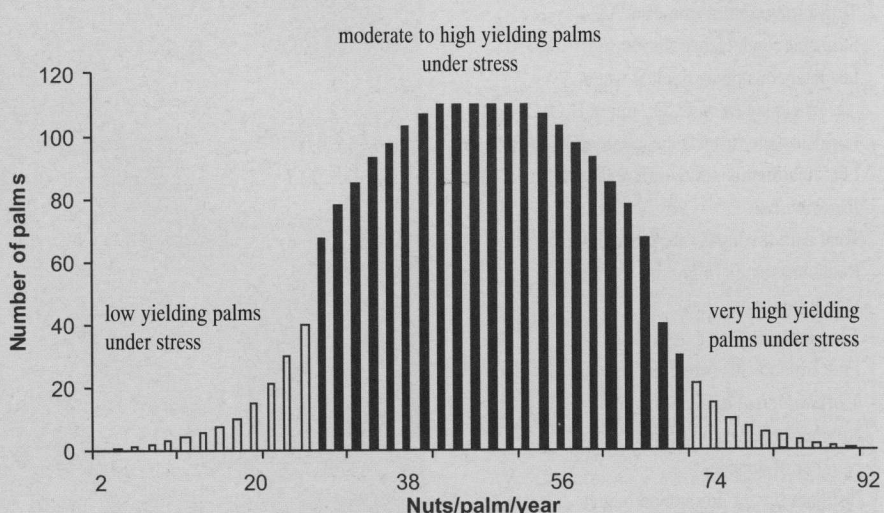

Fig 1: Improvement of yield potential of coconut gardens in stress-prone areas

6 to 8 drought years in about 40 years age. Continuous screening and selection of *in situ* drought tolerant palms and their usage in breeding programmes will result in pushing up the base nut yield levels under stress conditions due to the planting of selected progeny of these palms in drought prone and rainfed areas. This process will result in reduction or elimination of palms in low yielding category and increase in the frequency of palms under high and very high yielding category and ultimately lead to improved yield potential in drought prone and rainfed areas.

Surveys conducted in different agro-climatic zones resulted in the identification of *in situ* drought tolerant palms in farmers' fields (Naresh Kumar *et al.,* 2002). Identified palms were characterized for their tolerance to drought stress using morphological, physiological and biochemical criteria (Naresh Kumar *et al.,* 2002). It was found that these *in situ* tolerant palms had superior photosynthetic efficiency, water use efficiency and had better morphological characters like number of leaves and bunches (Table 1 and Fig 2) resulting in higher nut yield than in susceptible palms (Naresh Kumar *et al.,* 2002). Such tolerant palms can be used as the mother palms in breeding programmes.

Severely drought affected coconut garden

Table 1. Physiological, biochemical and morphological characters of *in situ* drought tolerant palms (mean of two years data collected on palms identified in farmers plots under different agro-climatic zones – adopted from Naresh Kumar *et al.*, 2002).

Parameter	*In situ* tolerant	Susceptible palms
Physiological		
Net photosynthetic rates (μ mol/m^2/s)	6.51 ± 0.39	4.68 ± 0.49
Transpiration rates (mmol/m^2/s)	2.43± 0.14	2.08 ± .18
Stomatal conductance (mol/m^2/s)	0.071 ± 0.005	0.056 ± 0.006
Instantaneous physiological water use efficiency (μ mol CO_2/ mmol H_2O)	2.67 ± 0.12	2.25 ± .11
Intrinsic water use efficiency (μ mol CO_2/mol air)	0.10 ± 0.004	0.097 ± 0.005
Leaf to air temperature difference (°C)	3.43 ± 0.19	3.62 ± 0.24
Biochemical		
Total carbohydrates (mg/g dry tissue)	137.0 ± 6.4	140.5 ± 7.1
Reducing sugars (mg/g dry tissue)	20.7 ± 3.5	19.7 ± 2.7
Starch (mg/g dry tissue)	55.0 ± 2.86	53.2 ± 3.2
Total proteins (mg/g dry tissue)	211.7 ± 5.5	210.2 ± 8.2
Free amino acids (mg/g dry tissue)	12.24 ± 0.7	11.8 ± .5
Morphological and yield		
Number of leaves on crown	32 ± 1.6	27 ± 1.5
Number of bunches	13 ± 0.7	11 ± 1.0
Pistillate flower production/bunch	28 ± 7.5	18 ± 3.7
Mature nuts/bunch	10 ± 1.3	4 ± 1.2

It is to be noted that above mentioned values are indicative of the performance of the palms in stress conditions. However they are not the benchmark values for selection of palms. Thus it is essential that the performance of the identified palms should be compared with those in the vicinity.

The important criteria for selection of the palms and their characterization are given below.

Selection of survey area

1) The locale of the survey should be stress prone (drought prone, salinity affected areas, etc.).
2) The fields selected should have been not receiving any management (neglected rainfed gardens).
3) The garden should have been affected by the stress factor and the general performance of palms reflect the stress effect
4) The farm/field should not have any water source

5) Gardens should have palms with age of at least 35 years or more

Method of selection of palms

1) Palms in those affected gardens should be selected based on desirable crown morphology, preferably during summer months.
2) Select best five palms in the garden and take the data on morphological characters such as number of leaves, number of pistillate flowers in the just opened bunch, number of buttons, first size nuts, tender nuts, immature nuts and mature nuts in subsequent bunches.
3) These palms can be physiologically characterized for water use efficiency, photosynthetic rates, etc, biochemical characters like epicuticular wax and leaflet anatomical characters.
4) It is desirable to analyze the nut characters such as copra and oil content in the selected palms.
5) Number these palms based on their performance from 1 to 5 (with oil paint).
6) Also collect similar data on some other palms in the vicinity for comparison.
7) Repeat the similar procedure in next garden and if some palms are out performing other palms in the next garden, replace the earlier selected tolerant palms with better performing ones.
8) This procedure can be repeated for the entire area
9) Collect data on pool of *in situ* tolerant palms in the area during next year as well (during similar months)
10) Based on the performance of palms in two consecutive years, select the best *in situ* tolerant palms from the entire area.
11) These palms may be used as the mother palms in breeding for stresses like drought tolerance, etc.
12) It is a must that the palms should meet the criteria set for the selection of mother palms such as
    i) Free from diseases
    ii) Palms should be at least 35 years old
    iii) Should yield at least 70 nuts/palm/year
    iv) Should have at least 32 leaves on the crown
    v) Should have typical characters of a cultivar

'in situ' drought tolerant palm with good yield potential

Identification and characterization of *in situ* tolerant palms will form as one of the approaches for utilization of field tolerant genetic resources in breeding for stress tolerance (Naresh Kumar, 2004; Rajagopal and Naresh Kumar, 2003; Rajagopal *et al.,* 2005). In order to exploit the naturally tested field tolerance, it is necessary that more number of palms should be identified based on large scale survey. Once identified, progeny of these palms should be checked for stress tolerance and seedling vigour before they are field planted. This approach will help in improving the overall productivity under rainfed and drought prone conditions.

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