accessions containing one or two B genomes (ABB, AAB and AAB plantains), as some relation is established with the B genome which tends to be more drought-tolerant than those with only the A genome[13]. It indicates that PVS2 exposure time is critical and not only genotype-specific but also explant- and method-specific (employed for cryopreservation). Also, droplet vitrification method using single meristem (isolation of uninjured single meristem from monocot is tedious and time-consuming) is not found to be user-friendly for cryopreservation of bulk banana germplasm[8].

Figure 2 *a–d* shows the different sequential stages of conversion of cryopreserved meristematic clumps into shoots. Shoots regenerated from +LN explants attained 2–3 cm height after 2–3 weeks compared to 3–5 cm of those regenerated from –LN explants. Irrespective of the cultivars and treatments, when 3–5 cm long shoots were transferred on M5 medium, 100% cultures regenerated 3–5 roots/shoot with a length 3–4 cm within 2 weeks on the rooting medium (Figure 2 *e*). No morphological difference was observed between the plantlets obtained from either –LN and +LN explants. Considering all cultivars and treatments together, 86–96% (non-significantly different) rooted plantlets survived hardening treatment and all the hardened plants survived in potted soil and field (Table 2) and grew normally (Figure 2 *f*).

The above described cryopreservation method was effective, practical and user-friendly for banana cultivars of subgroup Monthan. With the advantages of easy operation, less expenditure on laboratory equipment and a short processing time, this method will be useful for long-term conservation of banana germplasm. Using this method banana germplasm is being cryopreserved and till date, ten cultivars of banana (AB, AAB and ABB) have been cryopreserved at NBPGR. The cryopreserved plants have also been transplanted in the field for further evaluation.

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Effect of different number of coatings on gloss and in controlling moisture entry into mango wood

Very often, even with properly seasoned wood, dimensional instability is encountered due to possible moisture exchange between the product and the surroundings, wherein the usual suspect is the coating finish that is applied. Each coating material differs in its capacity to block the movement of moisture in and out of the product[1]. This is compounded by the lack of understanding regarding the amount of coating or the number of coats that needs to be applied. Usually, moisture excluding effectiveness (MEE) or water uptake coefficient (WUC) is determined to assess the ability of a coating to inhibit moisture penetration or escape to/from the wood. 'Seepage' or 'breathing' of moisture through the protective film and osmotic pressure of moisture in wood against the film cause adverse effects like reduction in gloss, cracking, blushing, haziness, blistering or peeling of the surface coating and the movement in wood, resulting in swelling and shrinkage[2]. This transport of moisture through the coating is determined either by steady-state methods, wherein the amount of moisture transported through a defined area in a specified time is measured or by sorption/desorption methods, where the change in weight of a test sample when the surrounding conditions change is measured. A mathematical treatment of these methods is discussed by Crank[3]. Feist *et al.*[4] have also discussed in detail about the determination of MEE, which has limitations due to the domination of wood characteristics rather than the finishing coat in the calculations. The water uptake method, on the other hand, estimates the actual amount of moisture intake by a defined weight of wood material in a given time.

The appearance of a wooden product is of prime importance as far as marketing is concerned, where measuring the gloss of the finish comes in handy. For furniture and top-class joinery work, spirit polishes are generally used, which to a great extent contribute acceptable glossy surface besides providing protection from atmospheric changes encountered in interior locations[1]. Nonetheless, the literature is practically devoid of any report on the behaviour of water uptake and gloss with varying amounts of coating material on a particular wood surface. In this context, an attempt has been made to understand the effects on moisture transport under complete moist conditions and on gloss levels with different number of spirit polish coatings on the surface of mango wood.

For moisture studies, fifteen samples of mango wood of equal size (2″ × 2″ × 1″) were made from planed planks, which were already seasoned up to 10.1% initial moisture content. These samples were sanded using sandpapers of grit size 80, 100 and 120, in that order. The weights of these samples were then recorded. Spirit polish was prepared by dissolving Shellac in denatured alcohol following standard procedures[5–7]. Sets of three samples each were then given 1–5 coats of polish by hand and were allowed to dry under sunlight. The weights of these polished samples were recorded and weights of coating material were calculated.

All the fifteen samples were then dipped in water, making sure that the surfaces of the individual samples did not abrade against other surfaces. These were taken out after 48 h and the surfaces were allowed to dry for about 15 min. They were again weighed to determine the amount of moisture that has penetrated into the samples through the polish. The percentage increase in weight of each sample was also calculated. The water uptake efficiency was calculated for each sample as:

$$\mathrm{WUE} = (\Delta W_t/\sqrt{t}),$$

WUE is the water uptake efficiency [g/√h]; ΔW_t the difference in weights before and after soaking the samples [g]; and $\sqrt{t}$ the square root of soaking time.

The observed percentage increase in weight was subjected to one-way ANOVA to observe any effects of the different number of coatings. WUE values were regressed against the actual weights of the coating material (irrespective of the number of coatings) to understand any possible relationship between them.

For gloss studies samples of size 8″ × 3″ × 1″ were prepared from similar planks as in the above case. Spirit polish also was applied as above, but only on one side of the samples and for each coating, eight samples were prepared. To prevent any moisture transport, the other five faces of the samples were given two coats of black bitumen paint. Measuring gloss at 60° has now been accepted as standard[8]. Gloss values at 60° were measured using a Tri Microglossmeter after allowing the samples to dry in air. The average of gloss values thus obtained was subjected to ANOVA to observe any significant differences in the gloss levels due to the differing number of coatings.

The effect of number of coatings on water intake through the coating was studied by assessing the percentage weight gain of the samples after each coat and also by calculating WUE. Observations on WUE are plotted in Figure 1. It can be seen from Figure 1 that the WUE drastically reduces from about 1.8 (corresponding to nearly 44% weight gain) after the first coat to about 0.72 (corresponding to about 18% weight gain) by the second coat. After the third coat, the value reduces to about 0.28, and thereafter it does not reduce so drastically. Though these results seem to be on expected lines, a quantification of the reduction in WUE is not reported in the literature.

The observed percentage weight gains in the samples were subjected to ANOVA and the mean differences were compared with the critical difference. It was observed that the weight gains differ significantly only up to the second coat. From the third coat onwards, the differences are insignificant. This is indicative of the fact that water intake through the spirit polish reaches a minimum from the third coat onwards. This reveals that for effective blocking of moisture under such extreme conditions, a minimum of three coats is necessary. However, it is to be kept in mind that when the product is to be used in the interiors where such soaking conditions may not be present, the third coat also may be done away with.

A linear regression between the WUE and weights of the coats resulted in a fairly good fit with $R^2 = 0.84$, and intercept as 1.6145 and regression coefficient as –4.1511 (both with significant P values). Figure 2 shows the fit of WUE against coat weights. The points are data from the experiment and the line is the regressed linear fit.

We can see that as the coat weight increases, the WUE decreases. This demands a look into the amount of polish that one

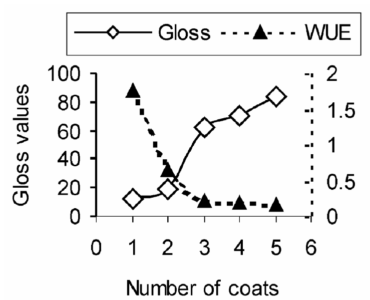

Figure 1. Effect of number of coatings on gloss and WUE.

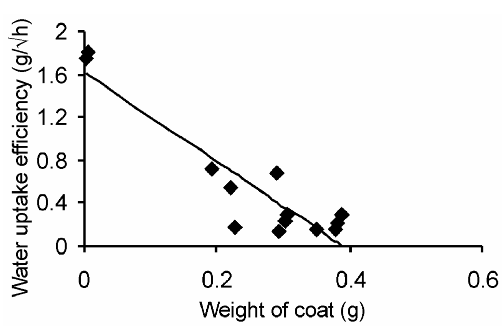

Figure 2. Regression of WUE against weights of coating material.

needs to apply to get an effective moisture-inhibiting property in service conditions.

The results on gloss measurements are also presented in Figure 1. They are slightly different from that of WUE in that the gloss does not show a drastic improvement with the second coat. It just climbed up to a value of about 19 from around 12. However, on applying the third coat, there was a drastic improvement in gloss to above 60 gloss units. Thereafter, though the gloss values showed a steady increase to the >70 and >80 values, the increase was rather steady. The ANOVA on gloss values showed that they increased significantly as the number of coats increased. This indicates that where a glossy look is the only criterion, we may go for more number of coats.

From the results it is evident that gloss values jump to higher levels from the third coat onwards. The WUE stabilizes to lower values from the third coat onwards. Thus a third coat of spirit polish on the surface of mango wood may bring in critical effects as far as glossy look and water-blocking properties are concerned. The apparent linear downward trend shown by the WUE against weights of coating material used points to the significance of standardizing the use of precious coating material on wood surfaces.

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