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In situ analysis of growth performance of the *Sal* clone (*Shorea robusta* Gaertn. F.) after transplanting in the field

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ABSTRACT

Sal, (Shorea robusta Gaertn. F.,) belongs to the family Dipterocarpaceae which mainly occurs in deciduous dry and in evergreen moist forest. Southern part of West Bengal once upon a time was recorded as harbor of luxuriant Sal forests. At present in South West Bengal Sal is the predominant species. But the existing forests are mostly in a degraded state of coppice. Regeneration is absent in greater part of the areas. The Sal forests in South - West Bengal have been facing problems in respect of their regeneration and their perpetuity has become a matter of worry to all concerned. Under these circumstances an attempt has been made to regenerate Sal forest by way of adopting the technique of vegetative propagation with the assistance of different higher concentrations of auxin and kinetin. Initially this experiment was carried out at Indpure Range location of Bankura(s) division. This attempt was successful and roots were initiated on shoot cutting. Latter on the replica of the same was conducted at the nursery of Simlapal Range under Bankura(s) division. Afterwards vegetative propagated Sal seedling were transplanted in the field in the year of 2007 and 2008 for studying the variation in height in different years. The experimental area is located in between 22°59'38.84" to 22°59'34.42" North latitude and 86°55'20.15" to 87°13'06.10" East longitude. The average elevation of the area is 57 meter (187 feet's AMSL) having a mean annual temperature 23.34°c and mean annual rainfall 1422.55 mm. The present study was related to the selection of vegetative propagated seedlings in progeny trial areas in accordance to their performance so that we could get better plants with faster growth and is likely to have better adaptability in degraded Sal forest areas.

Keywords **:** Hormones *root* imitation, Sal coppice, Sal coppice stlandard*, Shorea robusta.*

Human sustenance and security on earth is largely depends on production capabilities of land resources. For this reason it is so important to keep the land productive. While using this concept of production outmost care is required to be taken so that we will able to get better yield from land resources to cope up with the increasing population for our existence and for survival of our future generation. Therefore it can be said that the economic stability and wise use of land resources are inseparable.

A large part of the districts in South Bengal are characterized by lateritic soils and major parts of Purulia, Bankura, Midnapur and Birbhum come under this cover. The soils of South Bengal are having low organic content, acidic to neutral pH, higher concentrations of iron and alluminum oxides. The forests are consists predominantly of *Sal* trees in the lateritic areas as well as in most other part of the tract (the hills). The forests in general conform to $4B/C_2$ of Champion's Forest types and *Sal* forests come under category A_3 of *Sal* types - dry peninsular type of *Sal* trees. This tract of *Sal* forests, as observed, has a good regenerating power of through coppice[1] shoots. Apart from, *Sal* trees are the one of the most important hard wood species and by far one of the largest contributors to forest revenue in south West Bengal. Forests are evenly distributed more or less through the District. The condition of *Sal* forests in South West Bengal at present is far from satisfactory, although *Sal* is predominant species. The common associates of *Sal* forests are—mohua (*Madhuca latifolia*), kend (*Diospyros melanoxylon*), sidha (*lagestraemia parviflora*), parasi (*Cleistanthus collinus*), galgali (*Cochlospermum gossypium*), peasal (*Pterocarpus marsupiiim*), rahara (*Soymida febrifuga*). Kusiun (*Schliechera trijuga*), palas (*Butea monosperma*), arjun (*Terminalia arjuna*), haritaki (*Terminalia chebula*), asan (*Terminalia tomentosa*), bahera (*Terminalia belerica*), , semul (*Bombax ceiba*), gamar (*Gmelina arborea*), pial (*Buchanania latifolia*), *etc.*

The *Sal* forests have become the victim of adverse biotic interferences repeatedly in the past. As result of adverse biotic interferences, *Sal* forests in south West Bengal has given way to less inferior species. To avoid further retrogression in *Sal* forests, the silvicultural management system as has been following, is coppice with- slandered[2]. Although this management practices have been adopted in past, but these practices is being followed till this date. Further it has been observed that the volume yielding rate of coppice stools is gradually decreasing in nature with

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successive coppice rotation. Among the others, one of the reasons may be due to age of coppice stools. Besides this it has also been observed that the exploitable basal portions in some occasions are found to be hallowed due to fungus and virus attack. To avoid all these unforeseen incidences *Sal* forests in South Bengal are now regenerated in degraded blank forest areas by way 'Artificial regeneration[3]'. This management practices has been adopted with a view to get more valuable timber instead of getting of Sal poles. These approaches has been adopted and are continuing in restricted areas where the irrigation facilities will be available in dry summer season at least three years after planting of potted seedling.

Vegetative propagated seedlings were transplanted within the location Simlapal nursery as well as in the Range office areas in the year of 2007 & 2008 respectively to study the in situ analysis of height of the vegetative propagate *Sal* seedling. The experimental area is located in between 22º59'38.84" to 22º59'38.42" North latitude and 86º55'20.15" to 87º55'18.10" East longitude. The average elevation of the area is 57 meter (187 feet's) having a mean annual temperature 23.34^{0}c and mean annual rainfall 1422.55 mm**.**

MATERIALS AND METHODS

As per working plan prescription *Sal* coppice shoots were harvested in the year 2005 in the mouja of Susunia bearing J.L No-118 under Simlapal Range of the Bankura South division and after the completion of harvesting operations 5 numbers of *Sal* stumps were selected at randomly and each of the stump was marked as type–I, type –II, type–III, type–IV and type–V. Provision has also been made for future identification against the corresponding each type of stump. From the selected stump fresh *Sal* shoots which were coming out, were collected and were kept in separate identified bucket of type–I, type–II, type–III, type–IV and type–V respectively. Each type of bucket was partly filled up with sterile water to avoid desiccation due to dry temperature. The age of each harvested shoots for this experiment was in between 90-120 days old and they are usually 15 cm in length with one node and 2 to 2.5 cm collar diameter. Shoots were collected in the morning before sunrise and were brought to the nursery has been adopted in this experiment. The root initiation on *Sal* shoot has been taken place after 76 days. Thereafter type–I, type–II, type–IV and type–V were transplanted in July of 2007 in Simlapal nursery location and type–III was transplanted in August of 2008 in the Simlapal Range office location for close observations in their characteristics and for the observation of their growth rate. The annual increment of height in respect of type–I, type–II, type–III, type–IV and type–V against the corresponding years are tabulated in the table-1.

A few numbers of seed originated seedlings were also transplanted to the vicinity of vegetative propagated *Sal* seedlings in July 2007 and this was marked as type-6. The average annual increment in respect of height of seed originated transplanted potted seedling against the corresponding years onwards 2007 has been tabulated in the table-2. For future prediction of growth in respect of height was depicted in table- 3. Data was subjected to trend analysis and has been estimated by using simple linear regression.

RESULTS AND DISCUSSION

It will be not out of place to mention here that the vegetative propagule (Ramet) is a true copy of ortet (original seedling). The same thought has also been reflected in this method of vegetative propagation of *Sal* saplings, where the vegetative propagated seedlings in accordance to their type were transplanted in the nursery areas and the Range office location under the Simlapal Range in the month of July 2007 and July 2008. The main objective of this vegetative propagation was that the characteristics of each traits would be transmitted to ramets to produce a genetic copy of the mother plants. For this reason the growth in respect of increment of heights were taken in successive year after transplanting and were recorded in table-1 as annexed in the annexure-1. It appears from table-1 that there is a good variation in height in between vegetative propagated transplanted seedling, as because all these shoots cutting were collected from 5 (five) numbers stumps as identified previously. According to Zobel and Ikemori (1983), the transfer of non-additive characteristic is difficult through seed

Coppice[1]:- Coppice is that method of vegetative reproduction in which the tree, plants or the seedling of a specieswhen cut from near the ground level for producing coppice shoots.

Coppice with- slandered[2]: The Coppice with slandered system is that coppice system in which part of the crop is retained to from an uneven-aged over wood. Thus the resultant crop is two storied.

Artificial regeneration[3]: It is a method of the renewal of forest crop by showing, planting or other artificial methods. Artificial regeneration is a process of rising of *Sal* seedlings in nursery for transplanting in field. But the regeneration of *Sal* seedling and its associates are often found to miss the target for the fallowing reasons.

production approaches but is routinely possible through vegetative propagation. For this reason now a days the vegetative propagation is being increasingly used to reduce the gap between demand and supply.

From the aforesaid discussion it can be said clearly that the vegetative propagation is an application of genetic principle to grow a genetic alike plant for improvement and management of yield of crop. The clonal plantations have generated vast employment opportunities (35 million persons days) to the rural mass bringing in socio-economic prosperity (Kulkarni, 2008). However the application of treatment M_1C_1 (Soil + compost + cocopeat (1:1:1) + GA_3–150 ppm) was found superior for early as well as higher germination percentage, better shoot growth, better growth of tap root and secondary root production of papaya (Kumawat *et al,.* 2014). It appears further, that the processes of vegetative propagations is a processes genetic gains which can be captured in the progeny trail areas as mother plant for future availabilities of operational planting materials. It is unlikely to mention that the process of vegetative propagation enables the capture of genetically alike of the parents which may be difficult from seed originated seedlings.

On the other hand negative events cannot be ignored in the processes of vegetative propagations. The negative events, which may occur, are the wrong selection of mother plants. It appears from the table-1 that the vegetative propagated type of IV & V are the example of wrong selection. So it can be said based on the incremental performances in .respect growth of height that the type of IV & V is appeared to be poor performer.

Hence it can be said that *Sal* seedlings breeding programme may be started with the selection of best genotype[4] and best genotype may be preserved for future asexual multiplication of *Sal* seedlings.

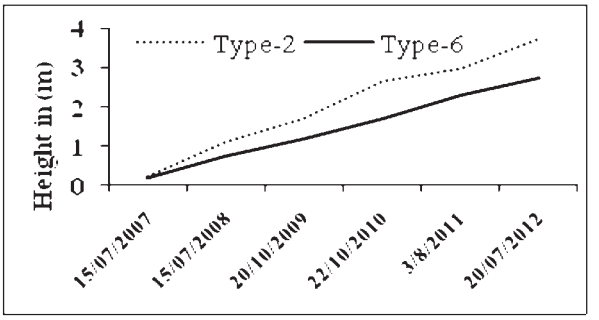

Fig. 1: Height of vegetative propagated seedlings of Type-1 and seed originated seedlings

A few number of well developed seed originated potted seedlings were transplanted in July 2007 in the same location. This was done with the objectives to analyze the genetic gain of vegetative propagated *Sal* seedlings in comparison to seed originated potted seedling. The average annual increment of height of seed originated *Sal* seedlings on wards of July 2007 was recorded in table-2.

The annual gain in height onwards of July 2007 in respect of vegetative propagated *Sal* seedlings of type-I, type-II, type-III, type-IV & type-V with respect to seed originated *Sal* seedlings are represented graphically in 1 to 5.

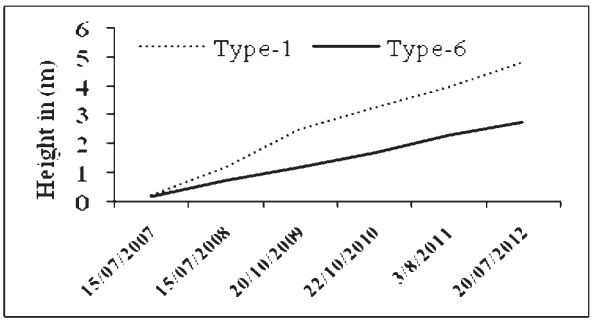

Fig. 2: Height of vegetative propagated seedlings of Type-2 and seed originated seedlings

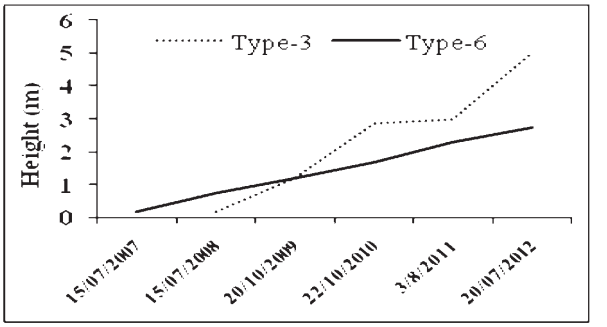

Fig. 3: Height of vegetative propagated seedlings of Type-3 and seed originated seedlings

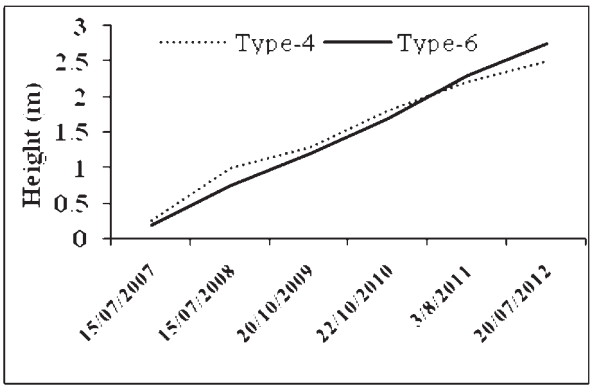

Fig. 4: Height of vegetative propagated seedlings of Type-4 and seed originated seedlings

genotype[4]: It may be considered as mother plants for vegetative propagation

Further it appears from fig.- 1 to 5 that the increment of height in respect of type-I *Sal* sapling is uniform throughout observations period after the year of transplanting in field and may be preserved for future asexual multiplication of *Sal* seedlings. On the other hand the increment in respect of height growth of type-3 is irregular and abrupt changes in height have also been observed in between the year 2011-2012. So the increment of height growth in respect of type-III is required to be observed closely for future prediction in the matter of preservation as mother plant.

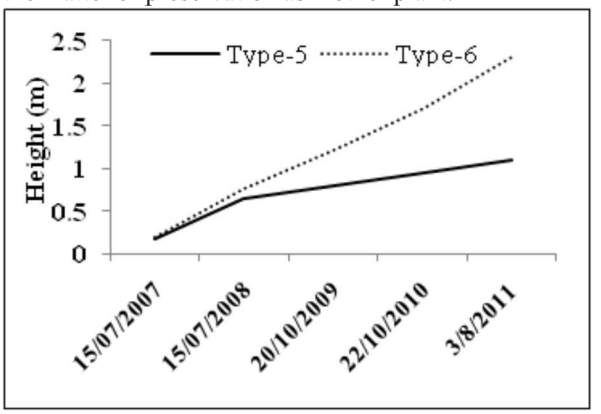

Fig. 5 : Height of vegetative propagated seedlings of Type-5 and seed originated seedlings

Standard deviation of type-I and type-III are much closed to each other and are 1.55 & 1.65 respectively. The standard deviation of type-II, type-IV, type-V and type-VI are 1.16, 0.75, and 0.73192 respectively.

Further it has been observed from table-1 & 2 that the annual increment of height of type–I, type–II, type–III, type–IV and type–V under the period of observations were varied widely. Therefore it is required to understand, to interpret, to evaluate change in growth phenomena more correctly and to anticipate the course of future events. Therefore, the detection in height of all types with respect to time series is crucial for planning and estimating yield management of all types *Sal* species under considerations. The least squares method gives us the most satisfactory results for finding the equation which best fits a given set of observation from the year July, 2007 to August 2012 against the corresponding height of *Sal* seedling. The estimated trend in respect to the height of *Sal* clone seedling has been stated in the table-3.

Graphical presentation of trend of incremental benefit of height of each type against the coresponding year has been depicted in Fig. 6.

It appears from the fig. 6 as well as increment of height data as recorded in table-1 and 2 that the type-V is showing peculiar digression from others and its trend is lower than even seed originated seedling. So, it should be removed from clone multiplication areas. Trend of Type-1 is decidedly sharper than others and

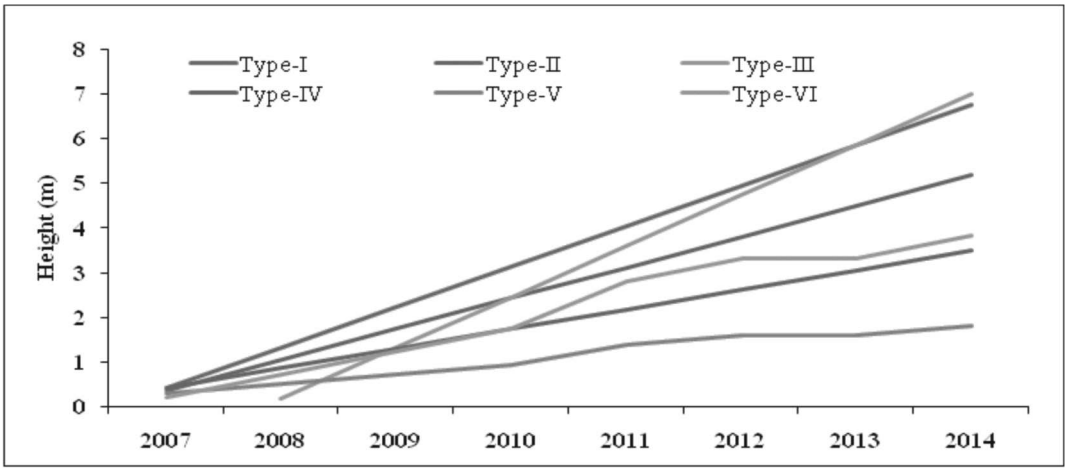

Fig. 6: Expected increment of height in respect of all types

may be preserved in progeny trial areas as mother plants. In case of clone Type-III although delayed in planting by one year but the sharp trend has also observed. Further in case of clone Type-4 whose trend line of growth rate is *at par* with the growth of seed originated seedling. So it should be removed from clone multiplication areas. Similarly for type –V whose trend line in respect of height growth shows far below than seed originated potted seedling So it should be desirable to remove from progeny trial areas. In case of type-II although a sharp trend has also been observed but the trend in respect height growth is comparatively far below than type-I & type-III. So it should not be desirable to preserve for future asexual multiplication of *Sal*.

Now a days vegetative propagation has become an integral part of effective tree improvement program. The art of application of vegetative propagation is not

only applicable to the forestry species but also this technique may apply to the hard wood species of Horticultural sectors as well as Agro-forestry sectors. It is the way not only to capture the genetic gain but also it includes the advantages in comparison to use potted seedling owing to overcoming in adequacy of seed supply and desired biological traits can be achieved. Further good vegetative propagated seed orchards if established, can lift the productivity and quality of dramatically.

Therefore, it has been rightly said that vegetative propagation approaches can hasten the progress production forestry. It is essential to develop aggressive management approaches in forestry to satisfy the demand for wood whether for fuel or for industrial purpose. The operations in forestry approaches development through vegetative propagation has both gain as well risk factor. The manager must decide the extent to which the gain can be achieved within acceptable level of risk (Toda, 1974).

Table 1: Observations of height in different years

Clone type	Date of planting	Height (m)					
		15/07/2007	20/07/2008	20/10/2009	22/10/2010	03/08/2011	20/7/2012
Type-I	15/07/2007	0.25	1.20	2.55	3.30	4.00	4.75
Type-II	15/07/2007	0.23	1.10	1.70	2.65	3.00	3.75
Type-III	10/07/2008	-	0.19	1.19	2.85	2.97	5.00
Type-IV	01/08/2007	0.26	1.00	1.30	1.80	2.20	—
Type-V	15/07/2007	0.17	0.65	0.80	0.95	1.10	

Table 2: Average height of seed originated sapling or pole aged

Year of seedling	Height of potted seedling (m)
1st	0.19
2nd	0.75
3rd	1.20
4th	1.70
5th	2.30

Table 3: Trend analysis of asexual of all type plants and seed originated plants

Type	Estimated trend against the corresponding ages in meters								
	2007	2008	2009	2010	2011	2012	2013	2014	2015
Type-1	0.415	1.319	2.223	3.127	4.031	4.935	5.839	6.743	7.647
Type-2	0.342	1.034	1.736	2.418	3.11	3.802	4.494	5.186	5.878
Type-3	-	0.16	1.30	2.44	3.58	4.72	5.86	7.00	8.14
Type-4	0.41	0.85	1.29	1.73	2.17	2.61	3.05	3.49	3.93
Type-5	0.302	0.518	0.734	0.95	1.166	1.382	1.598	1.814	2.03
Type-6	0.194	0.711	1.228	1.745	2.262	2.779	3.296	3.813	4.33

*Note:*Type-6 is a seed originating seedling*

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