INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print), 2222-5234 (Online)
http://www.innspub.net
Vol. 6, No. 2, p. 64-70, 2015

RESEARCH PAPER OPEN ACCESS

A study on regeneration status of *Dodonaea viscosa* in forest of Malakand division

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Key words: Regeneration, *Dodonaea viscosa*, forest, correlation, conservation.

http://dx.doi.org/10.12692/ijb/6.2.64-70 Article published on January 18, 2015

Abstract

This investigation was conducted in a forest area of Malakand Division Pakistan from 2012-13 to determine the natural regeneration status of *Dodonaea viscosa,* and correlate its regeneration intensity with slope, aspect, fuel wood collection area also to find out the total number of sapling in forest of Malakand division of *D. viscosa*. The natural regeneration capability of *D. viscosa* revealed that 18.33 % indicates excellent regeneration' 25.83 % shows good regeneration and 55.83% showed poor regeneration. In the whole forest of Malakand Division there are 1, 66, 78,779Seedling/saplings. The maximum regeneration was found on South-western aspect whereas minimum were found on the North-eastern aspect. Significant positive correlation was found between aspect and regeneration intensity. Terrain Slope and fuelwood collection intensity area had significant effect on the regeneration of *D. viscosa*. Further investigations are needed for the regeneration and conservation of *D.viscosa*.

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Introduction

Malakand forest division is located at the northern side of Khyber Pakhthunkhwa and southern aspect of Gilgit Baltistan. The forest of Malakand division falls in sub tropical zone characterized by Sub Tropical Scrub Forest at the lower elevation and Sub tropical broad leaves ever green Forest at the higher altitudes, having 4631 hectare forest area. These forests not only provide fodder and shelter for livestock, but also local community with medicinal plants, fuel-wood and non-timber forest produce like olives and Chir gum. People of the area also fulfill their daily fuel wood and timber requirements from these forests. Owing to diversified habitat, this Division has great potential for wildlife conservation (Anon 2012).

Dodonaea viscosa is a sand olive tree/ shrub belongs to family Sapindaceae. It is cosmopolitan found in rocky sites with poor soil of different altitudes. It is a small tree or shrubs with speedy growth reaching to 9 feet in height. Its stem has dark grey colored bark with exudates resin branches and sub sessile simple leaves. The inflorescence is terminal with small yellow to orange flowers bearing 4 sepals no petals and 2 to 3 wings capsular fruit containing 1-2 seeds. It has soil binder roots used for anti erosion, reclaim marshes, ornamentation, timber and medicinal like rheumatism purposes.

It is being lost at an increased rate, mainly as a result of rapid population growth, greater socio-cultural compulsions and the scarcity of alternative means of livelihood. From Socio-economic perspective, *D. viscosa* is the major species of subtropical forest in Malakand forest division, being the source of fuel wood, domestic use and marketing. There were dense forests of *Dodonaea* in the overall hilly area of Malakand in before three decades. Because of population growth and energy crisis, deforestation of the species has been increased in the recent past because of an increase demand for fuel wood. People of the area also fulfill their daily fuel wood and timber requirements from these forests. On eastern side, it is characterized by mountains of various altitudes while River Swat flows to the western side of the division. In between, the habitat is characterized by lush green agricultural fields, vast barren grounds, foot hills, mountains, many perennial and seasonal streams, and Bella to pine forests. Owing to diversified habitat, this Division has great potential for wildlife conservation. All the four species of partridges (chukar, See See, gray and black partridge) are found here; besides partridges, pigeons, doves, quails, falcons, hawks, hares, jackals, fox, porcupine, and many other wildlife species use this area as an abode. Several species of falcon visit this area. The River Swat and perennial streams provide staging grounds for different species of waterfowls migrating during winter season providing sport opportunity to the hunters. Moreover, Malakand is a business center and serves as a transit point for export of different wildlife species from northern parts of the province. (Anon 2012).

D. viscosa is being lost at an increased rate, mainly as a result of rapid population growth, greater socio-cultural compulsions, and the scarcity of alternative means of livelihood. Because of socio-political and tribal environment, conventional approaches to conservation, as shown in various official directives and rules, the limited capacity and resolve of the Forests and Wildlife Departments of the provincial governments of Khyber Pakhtoonkhwa, have been of little help either in controlling the unsustainable harvesting of *D. viscosa* in Malakand Forest Division or taking any preventive measure for the protection of *D. viscosa*.

Objectives of the current research work is To correlate the regeneration of *Dodonaea viscose* with respect to slope, Fuel wood collection, also to find out the total number of seedling/sapling in the study area and its impact on ecosystem. Since the present study indicated that the regeneration was good on the Southern aspect, new plantation should be raised on Southern aspect. This study is intended to present the current regeneration status of the *Dodonaea* and also to persuade the natural resource conservation agencies to take necessary actions regarding the conservation of the specie.

Material and methods

Different methodology has been adopted for this research work. Some of these are followings:

Field t survey

Grid sampling technique was used for the field measurement. Keeping in view the time, cost and crop variability and terrain etc, a total of 120 plots were taken in the forest, using 0.1 % sampling intensity. Size of each plot was 0.01 hectare (0.02471 Acres) with circular shape having 5.64m radius (shown below). Total number of plots (120) were equally divided in the area such as I km². For equal distribution of these plots and to avoid biasness, a grid was drawn on the known scaled map of the area. A map having scale 1:50000 was selected and a grid of 2 x 2 cm (100 ha according to the scale) was fixed on it. Sample plot was taken in the center of each grid. In the map, position of the plots was taken with the help of topo sheet of the area and its location on the ground was determined through GPS.

Distribution of sample plots

Five sites were selected for sampling plots in the whole Malakand Forest Division. Three sites were from Dargai Forest Sub-division: each site was at the hills of Totai, khanoray and Palai. Two sites were from Batkhela Forest Range: each site was at the hills of Totakaan and Thana. 25 sampling plots were assigned to the each of the above mention areas. Total of 120 sampling plots were selected from the whole Malakand Forest Division.

Data Collection

On each sample plot, regeneration status was recorded through counting. The data was entered into data collection sheets and then transferred to the computer (MS-Excel). This was helpful in the calculation of regeneration status per hectare and data analysis. The collected data was analyzed using MS-Excel.

Questionnaire Survey

A questionnaire survey was conducted from the local community to get information about the importance, income and regeneration status of the *Dodonaea viscose* and any change they felt in the regeneration status and causes of perceived change within the past ten years.

Results and discussion

Regeneration Status

To ascertain the regeneration status of *Dodonaea viscosa*, the data was arranged in three groups-Poor regeneration, medium regeneration and good regeneration. A sample plot having up to 30 saplings was classed as "poorly regenerated", plots with 30-40 saplings was called "medium" while plots with more than 40 saplings/ 0.01 ha was classed as having "good" regeneration respectively. The survey indicated that 67 sample plots (55.83%) have a very poor regeneration 31 plots (25.83%) have a fairly good regeneration while 22 plots (18.33%) have good to excellent regeneration. Considering the above calculation, it was estimated that there are 1, 66, 78,779 Seedling/saplings in the whole Malakand Forest Division Fig (1).

Table 1. Regeneration Status (in Numbers) of 3 Slopes: Gentle, Moderate and Steep.

Replication	Gentle	Moderate	Steep	Total	Mean
R-1	55.00	52.00	45.00	152.00	50.66
R-2	52.00	51.00	44.00	147.00	49.00
R-3	49.00	54.00	47.00	150.00	50.00
R-4	53.00	57.00	46.00	156.00	52.00
R-5	56.00	61.00	43.00	160.00	53.33
R-6	61.00	50.00	43.00	154.00	51.33
R-7	65.00	48.00	40.00	153.00	51.00
R-8	55.00	45.00	38.00	138.00	46.00
Total	446.00	418.00	346.00	1210.00	403.32
Mean	56.00	52.00	43.00		

Impact on Ecosystem

In the whole Malakand Forest Division, people facing severe shortage of fuel wood, as there is scarcity of the alternative source of fuel wood energy. The Locals cannot effort LPG (Liquefied Petroleum Gas) on regular bases, and use forest as fuel wood on domestic as well as for commercial purposes. Beside this the Agro-forestry was not will establish to fulfill fuel wood demand of the locals. Some people in the area were far off from commercial area, and fuel wood (*Dodonaea viscosa*) are easily available to them (Anon 2010). Some locals are permanently living in hilly sites; they are unaware of the forest importance, so they use natural resources unsystematically. For the survival of their livestock, they use rangeland beyond the carrying capacity, and were causing a lot of damage to the regeneration of *D.viscosa*. Some of the impacts on ecosystem due to excessive deforestation of *D.viscosa* forestas fuel wood are: during last few decades the hill become barren and springs are dried. It may lead to soil erosion. *D.viscosa* is a good habitat for black partridge, but due to the excessive deforestation, habitat was destroyed. The grazing of animal and walking of human beings can disturb the ecosystem of forest.

Table 2. Regeneration Status (in Numbers) of 3 fuel wood collection area: High, Medium and low.

Replication	High	Medium	Low	Total	Mean
R-1	44.00	52.00	56.00	152.00	50.66
R-2	47.00	53.00	55.00	155.00	51.66
R-3	46.00	50.00	60.00	156.00	52.00
R-4	46.00	54.00	61.00	161.00	53.66
R-5	48.00	54.00	58.00	160.00	53.33
R-6	45.00	56.00	60.00	161.00	53.66
R-7	40.00	55.00	70.00	165.00	55.00
R-8	41.00	51.00	62.00	154.00	51.33
Total	357.00	425.00	482.00	1264.00	
Mean	45.00	53.00	60.00		

Correlation of regeneration intensity of Dodonaea viscosa with respect to slope, aspect and fuel wood collection intensity

Terrain slope versus number of seedlings

Logically, steeper the terrain less should be the regeneration. An easy terrain must have a better regeneration because of the reduced surface run-off, better soil quality with depth humus layer and the greater possibility of the establishment of regeneration. Therefore, there must be a positive relationship between the terrain slope and the regeneration status. Vegetation grown on slope can Influencing the physical stability of slopes by root arming, weight of trees and wind induced forces (Ziemer, 1981, Beinsteiner, 1981, Sidle, 1991, Bischetti *et al.* 2004). According to the survey, 27 plots (22.5%) of the total were in the terrain having a slope of up to 30%, 50 (41.7%) in medium steep terrain with a slope ranging between 30 and 60%, 43 plots (35.83%) in steep terrain having a slope of more than 60%.

Table 3. Regeneration Status at various sample plots in the three different aspects including North-East, South-West and Plain.

Sample Plots	South-West	Plain	North-East
1	35.00	25.00	20.00
2	32.00	26.00	19.00
3	30.00	27.00	16.00
4	32.00	28.00	19.00
5	34.00	25.00	18.00
6	30.00	29.00	20.00
7	31.00	27.00	14.00
8	28.00	26.00	15.00
Average	31.50	26.60	17.60

Effects of slope on Regeneration Status

Effects of Treatments

The tabulated value of 'F' for 2 and 14 Degree of Freedom (DF) is 3.74 at significance level '0.05' (i.e. at probability level 95%), while the calculated value of 'F' is 12.85 which is more than 3.74. This means that the treatment (Slope) had significant effect on the Regeneration Intensity.

Table 4. Regeneration Status of 3 Aspects: North-East, Plain and South-West.

Replication	North-East	Plain	South-West	Total
R-1	35.00	25.00	20.00	80.00
R-2	32.00	26.00	19.00	73.00
R-3	30.00	27.00	16.00	65.00
R-4	32.00	28.00	19.00	72.00
R-5	34.00	25.00	18.00	67.00
R-6	30.00	29.00	20.00	65.00
R-7	31.00	27.00	14.00	72.00
R-8	28.00	26.00	15.00	69.00
Total	252.00	213.00	141.00	606.00
Mean	31.50	26.00	17.60	

Effects of Replications

"F" value from Table for 7 and 14 df is 2.85 at significance level '0.05'. The computed value of 'F' is 0.562, which is less than 2.85. Thus the replications had no significant effect on the results. In other words, there was no difference in the regeneration intensity of *Dodonaea viscosa* in various replications (Table 1).

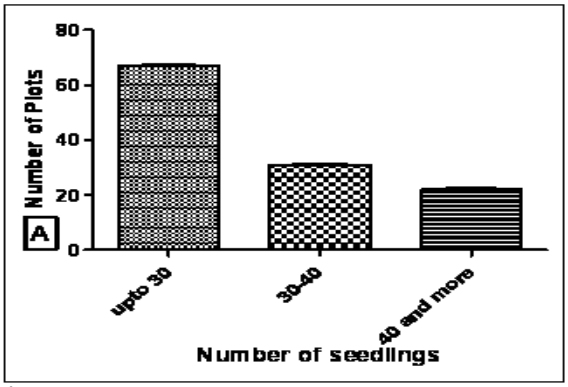

Fig. 1. Number of seedlings of *Dodonaea viscose* in forest of Malakand division.

Fuel wood collection intensity versus number of seedlings/saplings

Dodonaea viscosa is the major source of fuel in the study area so that the collection of *D.viscosa* as fuelwood is high in overall Malakand Forest Division. However there were some points which cannot be accessible to collect the fuel wood. During survey the plots were taken in three areas regarding to fuel wood (*D.viscosa*) collection intensity i.e. high collection area, medium collection area and low collection area (Markart*et al.,* 2004, Markart *et al.,* 2006,Thielen, 2007).It is clear that where the collection intensity is low, the availability of seed will be more and hence regeneration intensity will be high (Table 2).

Effects of Fuel wood collection intensity area on Regeneration Status

Effects of Treatments

This means that the treatment (Fue lwood collection intensity) had significantly affected the Regeneration Intensity. In other words, there was no difference in the regeneration intensity of *Dodonaea viscosa* in various replications (Table 3). Our findings are in line with that of (Tobias, 2003).

Aspect versus number of seedlings/saplings

In physical geography, aspect generally refers to the horizontal direction to which a mountain slope faces. For example, a slope on the eastern edge of the Rockies toward the Great Plains is described as having an easterly aspect (Wikipedia). Logically, the

aspect should have a direct relationship with the intensity of regeneration. This is because the northern aspect is cooler and humid as compare to southern aspect which is hot and dry. In the northern hemisphere, south-facingslopes (SFS) may receive as much as six times more solar radiation than north-facing slopes (NFS). Thus, the SFS has a more xeric environment, that is, warmer, drier and a more variable microclimate, than the mesic NSF. Although located only a few hundred meters apart and sharing the same macroclimatic zone, the microclimatic conditions on the slopes vary dramatically; affecting the biology of organisms at all levels (Nevo, 1997 and 2001). Here with us *D. viscosa* is light demander so the specie will survive well on Southern aspect. After arranging the sampled data in three groups - North-east, South-west, and Plain - the number of seedlings and saplings, essentially being the indicators of regeneration (good or bad), were grouped together. The data indicated that the maximum sample plots (53.33%) were supporting saplings on South-western aspect whereas minimum (15.1%) were found on the North-eastern aspect Fig (2) and Table (3).

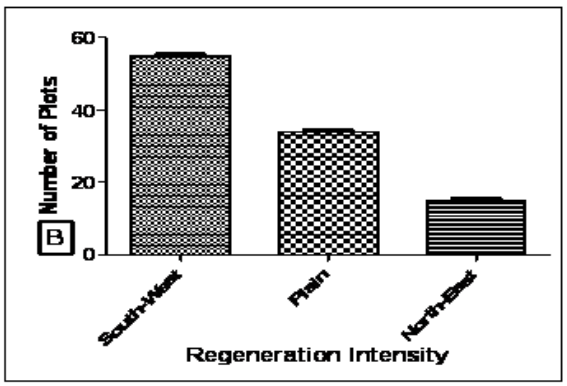

Fig. 2. Regeneration status in different aspects of *Dodonaea viscosa*in forest of Malakand division.

Effects of Aspect on Regeneration Status

The treatment (Aspect) had significantly affects the Regeneration Intensity. In other words, there was no difference in the regeneration intensity of *D. viscosa* in various replications (Table 4). Medicus (2009) findings also supported our results.

Conclusion

According to the survey, the regeneration was good in the area where the fuel wood collection was low, so the collection of the fuel wood should be reduce in some area to improve the regeneration. Since the current findings indicated that the regeneration was found healthy and stronger on the Southern aspect, new plantation should be raised on same region.

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