GERMINATION AND SURVIVAL OF SEEDS OF FIVE ACACIA SPECIES UNDER NURSERY CONDITION IN POTHWAR.

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ABSTRACT

The study was conducted in the field area of agro-forestry nursery in Range land Research (RRI), in NARC, Islamabad. The area experiences a mean annual rainfall of about 959 mm with average annual temperature of 21.4 °C in Pothwar region, the climate in this region is warm and temperate. In winter, there is much less rainfall than in summer. The seeds of five *Acacia* species (*Acacia stenophyllah (sunehri har), Acacia ampliceps* (salt wattle), *Acacia farnensiana (gul kikar), Acacia correceana,* and *Acacia catechu* (cutch tree) were collected from healthy mother plants from different dry eco-zones. These healthy seeds graded and no chemical or mechanical treatments were applied. The Polythene tubes were filled with three media of clay only, Farmyard manure +Clay+ Sand and Compost +Sand+ Clay. Each medium was consist of 250 tubes and every medium consisted of 50 seeds respectively. Data was collected every day for three weeks on germination of seeds, days to seed germination, days to appearance of first leave, days to appearance of 3 leaves, seed germination percentage, plant height, root/shoot length, and ratio,

fresh and dry matter, and biomass yield assessments were done for each plot at a month after establishment. At the end of the third week's period, all seedlings of each species were pulled out with roots, oven-dried at 70 ° C for 72 hours, and then weighed. It was cleared that the *Acacia correceana* gave the highest (22%) germination percentage in farmyard manure compositions. In compost compositions, again the same species i.e., *Acacia correceana* gave the maximum germination percentage of (36%). In the clay medium compositions all the species tested, *Acacia ampliceps* gave the highest germination rate (20%), followed by the *Acacia correceana* (20%). Similarly root/shoot growth ratio for all the species were recorded. The data revealed that the dry weight of the *Acacia correceana* gave the highest 0.52 g and was significantly different, with followed by the species, *Acacia ampliceps* 0.42 g. Similarly, in shoot weight the same species *Acacia correceana* produced the highest weight 0.78 g, which was also significantly different, while this species was followed by the *Acacia ampliceps* with 0.61 g dry matter yield. Hence, there were non-significant difference in root/shoot ratio in terms of phyto-mass above and below. It had the good ability for biomass production, and soil conservation in arid and semi-arid areas of Pakistan.

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Keywords: Biomass production, Carbon sequestration, FYM, Compost, Clay and Root shoot ratio

INTRDUCTION

The present research effort was carried out to present the germination and survival of seeds of five acacia species under nursery condition located in the Pothwar region of Pakistan. Pothwar region lie on the about 5,000 sq. m (13,000 sq. km) land and 1,200-1,900 feet's (350-375 m) in elevation (Adnan et al., 2009). Around 10% of agricultural activities are contributed to the total agricultural production. (Ashraf et al., 2007). This region has semiarid-sub humid zones with hot summers and cold winters except Murree, which falls in humid zone most of the year (Chaudhry and Rasul

2003 and 2004). Due to geological and biological variation in Pothwar region it has rich biodiversity in floral and final. Variation in its geology i.e. mountains, plateau, climatic condition make this region hotspot for the biodiversity. Due to lack of infrastructure and communication the natives of the region are closer to the natural resources. The region is rich in rural culture and conventional customs. People's occupations are at the mercy of native flora and fauna.

The *Acacia* genus is a large group of leguminous large plants and shrubs which comprising more than 1000 species distributed worldwide in warmer latitudes i.e. Australia, Africa, the Middle East, Asia and the Americas (Anonymous, 1983). As legumes, acacias are considered important in the nitrogen cycle as they promote soil fertility through biological N fixation. A few *Acacia* species, both exotic and indigenous (N kaonja, 1985), have previously been included in the dry-zone species trials in Malawi. In these trials, unfertilized *Acacia mangium* from Australia showed comparable survival and growth with fertilized *E. camaldulensis* and *E. tereticornis*. The success of *A. mangium* in these trials stimulated interest to explore a wide range of Australian dry-zone acacias for use in social forestry and agroforestry programs in Malawi. Few of these have been tested in plantations in Australia or as exotics elsewhere. As a result, no information on nursery and establishment techniques is available for most of the species (Turnbull, 1986). There is therefore an urgent need to identify and test fast-growing species with multiple benefits for use in social forestry and agro- forestry schemes in the dry areas of the country. Such species should be easy and cheap to establish and should combine well with the growing of food crops (Ngulube, 1988). On the other hand, the plantation has high positive effect on soil carbon (C), nitrogen (N) and texture formation (Hofstede et al., 2002; Kooch and Zoghi, 2015; Li et al., 2017) but the research regarding the contribution of

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plantation was not done. Moreover, it is more interesting fact that the soil carbon, nitrogen and texture are so sensitive to the vegetation that these were differed even at “root zone” and “location between the plants (about 1-1.25m away from root zone)” as well.

This research paper presents results of a nursery study of germination and survival of seeds of five different *Acacia* species under conditions in Pothwar region of Pakistan. The seedlings were meant for use for dry-zone species trials in the country. The plantation of five different *Acacia* species, was carried out targeting to germination and survival study of their seeds with their growth percentage, and root/shoot ratio under different porting media in nursery conditions at Pothwar at region Punjab, Pakistan.

MATERIALS AND METHODS

3.1 Study area

The study was conducted in the field area of plot no B-24 agro-forestry nursery in Range land Research (RRI, 33°39'56.1"N, 73°07'21.9"E) (33.665587, 73.122738 GPRS) at an elevation of about 527.0 m (1729.0 feet) in NARC, Islamabad. The area experiences a mean annual rainfall of about 959 mm (37.8 inch) with average annual temperature of 21.4 °C (70.6 °F) in Pothwar region, the climate in this region is warm and temperate. In winter, there is much less rainfall than in summer (climate-data.org).

3.2: Study design

The seeds of five *Acacia* species (*Acacia stenophyllah (sunehri har), Acacia ampliceps* (salt wattle), *Acacia farnensiana (gul kikar), Acacia correceana,* and *Acacia catechu* (cutch tree) were collected from healthy mother plants from different eco-zones. These healthy seeds graded and no chemical or mechanical treatments were applied. The Polythene tubes were filled with three media of clay only, farmyard manure +clay+ sand and compost +sand+ clay. Each medium was consist of 250 tubes and every medium consisted of 50 seeds

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respectively. The set of every medium has five species *Acacia stenophyllah (sunehri har), Acccia ampliceps* (salt wattle), *Acacia farnensiana (gul kikar), Acaccia correceana, Accacia catechu* (cutch tree) was studied.

The detail list of the multipurpose tree seeds under different media involved in the study are presented in Table 1 and 2 respectively.

S.no	Species	Locality	Latitude	Longitude	Altitude
1	*A. ampliceps*	Pothwar	33°39'56.1"N 33.665587	73°07'21.9"E 73.122738	527.0 m
2	*A. catechu*				
3	*A. correceana*				
4	*A. farnensiana*				
5	*A. stenophylla*				

Table-1: Pothwar dry-zone *Acacias* and site details of their seed origin

S.no	Soil Composition by %	Specie/replica/ tubes
1	Clay (100)	5/50/250
2	*FYM/Clay/Sand (33.3 each)	5/50/250
3	**OC/Clay/Sand (33.3 each)	5/50/250

* FYM- FarmYard Manure

** OC- Organic Compost

Table-2: Different soil media involved in the study

The seeds was directly sown in black polythene tubes (10 cm diameter, 15 cm deep) containing woodland soil during monsoon seasons. The seeds were sown at a depth of 5-10 mm. Seed germination was observed on daily bases till sprouting (day 7). Watering was done twice a day, morning and evening, except on days when it rained, during which no watering was done. After 7 days in the nursery, a replicate plot of each species was established in each of the 3 blocks. Each plot consisted of 50 seedlings (per specie). Watering continued as before throughout the study period. Weeds were removed on detection and root pruning was done to all the species when- ever roots penetrated the nursery bed soil.

3.3: Experiment Design

Experiment was conducted in a Randomized Complete Block Design with three replications.

3.4: Data Collection

Data was collected every day for three weeks on germination of seeds, days to seed germination, days to appearance of first leave, days to appearance of 3 leaves, seed germination percentage, plant height,

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root/shoot length, and ratio, fresh and dry matter, and biomass yield assessments were done for each plot at a month after establishment. At the end of the third week's period, all seedlings of each species were pulled out with roots, oven-dried at 70 ° C for 72 hours, and then weighed.

3.5: Data Analysis

Data was analysed by method describe by (Steel and Torrie, 1997) and were further subjected to analysis of variance (ANOVA) and Duncan's multiple range tests with help of excel.

RESULT AND DISSCUSSION

Seed germination percentage

The results of germination percentage of different *Acacia* species are given in Table-3. It was observed from the table-3 the *Acacia correceana* gave the highest 22% germination percentage in farmyard manure compositions, followed by the *Acacia ampliceps* 20%. In compost compositions, again the same species i.e. *Acacia correceana* gave the maximum germination percentage of 36%, while in case of *Acacia ampliceps,* germination percentage was merely 28%. In the pure clay medium compositions all the species were tested, *Acacia ampliceps* gave the highest germination rate 20%, followed by the *Acacia correceana* 20%.

S.no	Species	FYM	OC	Soil
1	*Acacia ampliceps*	20^{ab}	28^{b}	20^{a}
2	*Acacia catechu*	18^{cb}	26^{bc}	12
3	*Acacia correceana*	22^{a}	36^{a}	15^{b}
4	*Acacia farnensiana*	13^{e}	20^{d}	4^{d}
5	*Acacia stenophylla*	15^{d}	18^{de}	7^{c}

Means with different superscripts differ significantly ($P<0.05$)

Table-3: Percentage germination of multipurpose tree seeds under different media.

Root/shoot growth ratio

The result of root and shoot length and their ratio are given in Table-4(a, b, & c). Data revealed that the shoot length of *Acacia correceana* observed the highest shoot length of 60.9 cm, followed by *Acacia ampliceps* 48.76 cm. Similarly in root length the same

species i.e. *Acacia correceana* recorded the maximum length in root 12.7cm, followed by the species *Acacia ampliceps* with root length of 9.0 cm. Results indicated that there were similarity in root/shoot ratio above and below the medium, which means that all of were good for biomass production as a fodder,fire wood and soil conservation especially in arid and in semi arid areas of Pakistan.

S. No	Species	Shoot length, cm	Root length, cm	Root/Shoot Ratio
1	*Acacia ampliceps*	48.76^{b}	9.0^{ba}	0.18^{bc}
2	*Acacia catechu*	39.62^{cd}	7.6^{ef}	0.19^{abcd}
3	*Acacia correceana*	60.96^{a}	12.7^{a}	0.20^{a}
4	*Acacia farnensiana*	36.57^{e}	6.6^{de}	0.18^{cd}
5	*Acacia stenophylla*	42.67^{bc}	8.9^{cb}	0.20^{a}

Means with different superscripts differ significantly (P<0.05).

Table-4(a): Effect of shoot, root and their ratio on species in FYM in field area of NARC

The effect of above parameters were examined in three media (compost, clay and sand) in nursery condition in range land Research Institute, NARC. The result of five *Acacia* species were analyzed for three parameters of shoot length cm, root length cm and root shoot ratio in lab. The result revealed that *Acacia correceana* species gave the maximum result and showed significant difference in shoot length, root length and in root shoot ratio among the other *Acacia* species and followed by the *Acacia ampliceps.* Similarly, in root shoot ratio data of *Acacia correceana* gave the least significant difference among the other *Acacia* species.

Species	Shoot length, cm	Root length, cm	Root/Shoot Ratio
Acacia ampliceps	52.00^{b}	11.0^{ba}	0.40^{bc}
Acacia catechu	40.60^{cd}	8.2^{ef}	0.50^{abcd}
Acacia correceana	74.20^{a}	20.5^{a}	0.60^{a}
Acacia farnensiana	42.50^{e}	8.6^{de}	0.31^{cd}
Acacia stenophylla	48.50^{bc}	9.8^{cb}	0.50^{a}

Means with different superscripts differ significantly (P<0.05).

Table-4(b): Effect of Shoot, Root and their ratio of three Acacia species in three media (compost, clay and in sand) in field area of NARC

In Table 4 (c) the result showed that *Acacia correceana* gave the maximum shoot length, root length and also in root shoot ratio among the other species and followed by the *Acacia ampliceps* species in clay in the field area of Rangeland Research Institute, NARC.

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Species	Shoot length, cm	Root length, cm	Root/Shoot Ratio
Acacia ampliceps	40.20^{b}	7.40^{ba}	0.12^{bc}
Acacia catechu	32.20^{cd}	6.5^{ef}	0.14^{abcd}
Acacia correceana	50.90^{a}	10.30^{a}	0.15^{a}
Acacia farnensiana	26.70^{e}	5.20^{de}	0.10^{cd}
Acacia stenophylla	32.50^{bc}	6.90^{cb}	0.15^{a}

Means with different superscripts differ significantly (P<0.05).

Table 4 (c): Effect of Shoot, Root and their ratio of three *Acacia* species in on media (clay) in field area of in NARC

Root/shoot biomass (fresh/dry)

Data of all the species were observed in root and shoot fresh and dry matter yield [Table-5(a, b, & c)]. The data revealed that the dry weight of the *Acacia correceana* gave the highest 0.52 g and was significantly different, with followed by the species, *Acacia ampliceps* 0.42 g. Similarly, in shoot weight the same species *Acacia correceana* produced the highest weight 0.78 g which was also significantly different, while this species was followed by the *Acacia ampliceps* with 0.61 g dry matter yield.

Species	Root fresh wt., gm	Root dry wt., gm	Shoot fresh wt., gm	Shoot dry wt., gm
Acacia ampliceps	1.07^{b}	0.42^{b}	1.60^{b}	0.61^{b}
Acacia catechu	0.78^{d}	0.31^{de}	1.33^{d}	0.50^{d}
Acacia correceana	1.40^{a}	0.52^{a}	1.98^{a}	0.78^{a}
Acacia farnensiana	0.67^{e}	0.27^{d}	1.21^{ed}	0.47^{de}
Acacia stenophylla	0.93^{cb}	0.38^{bc}	1.53^{cb}	0.59^{bc}

Means with different superscripts differ significantly (P<0.05).

Table-5(a): Effects of root shoot fresh and dry weight of species in FYM in area of NARC

The result indicated in table 5 (b) the root weight and their shoot weight gave the maximum in *Acacia correceana* species among the other *Acacia* species and followed by the *Acacia ampliceps* in proper media(compost, sand and clay) in field area of RRI,NARC.

Species	Root fresh wt. gm	Root dry wt.gm	Root dry Carbon stock kg/ha	Shoot fresh wt. gm	Shoot dry wt. gm	Dry shoot Carbon stock kg/ha
Acacia ampliceps	1.80^{b}	0.99^{b}	4.95^{b}	1.78^{b}	1.05^{b}	5.25^{b}
Acacia catechu	1.10^{de}	0.66^{de}	3.30^{d}	1.50^{d}	0.90^{d}	4.50^{d}
Acacia correceana	2.45^{a}	1.47^{a}	7.35^{a}	2.40^{a}	1.44^{a}	7.20^{a}
Acacia farnensiana	0.90^{e}	0.54^{e}	2.70^{e}	1.45^{ed}	0.87^{de}	4.35^{ed}
Acacia stenophylla	1.40^{c}	0.84^{bc}	4.20^{c}	1.75^{cb}	1.05^{bc}	5.25^{cb}

Means with different superscripts differ significantly (P<0.05).

Table 5 (b): Effects of root shoot fresh and dry weight of species in compost media and their carbon stock in field area of NARC

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In table 5 (c) the result revealed that the species *Acacia correceana* showed the highest root dry and shoot dry weight among the other Acacia species and followed by the *Acacia ampliceps* in field area of RRI,NARC.

Species	Root fresh wt. gm	Root dry wt. gm	Root dry carbon stock kg/ha	Shoot fresh wt., gm	Shoot dry wt. gm	Shoot dry carbon stock kg/ha
Acacia ampliceps	0.90^{b}	0.54^{b}	2.70^{b}	1.41^{b}	0.85^{b}	4.25^{b}
Acacia catechu	0.67^{d}	0.48^{de}	2.40^{c}	1.10^{d}	0.66^{d}	3.30^{d}
Acacia correceana	1.10^{a}	0.66^{a}	3.30^{a}	1.62^{a}	0.97^{a}	4.85^{a}
Acacia farnensiana	0.53^{e}	0.32^{d}	1.60^{e}	1.00^{ed}	0.60^{de}	3.00^{ed}
Acacia stenophylla	0.75^{cb}	0.45^{bc}	2.25^{dc}	1.33^{cb}	0.80^{bc}	4.00^{c}

Means with different superscripts differ significantly ($P<0.05$).

Table 5 (c): Effects of root shoot fresh and dry weight of species in clay and their carbon stock in field area of NARC

FINDINGS

Results indicated that there were similarity in root/shoot ratio in terms of phyto-mass above and below. Which means that all of them had the good ability for biomass production and soil conservation in arid and semi-arid areas of Pakistan.

Recommendations: *Acacia* species may be planted on large areas in the semi-arid and dry areas for fodder, fuel wood and for soil conservation. The information could be used by researchers, planners, forest departments and other linked department for growing of trees in different suited eco-zones of Pakistan.

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