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Effect of planting material and distance on establishment yield of *Asystasia intrusa*

(Kesan bahan dan jarak tananam terhadap pengeluaran *Asystasia intrusa*)

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Key words: *Asystasia intrusa*, planting materials, planting distance, yield

Abstract

The effect of planting material and distance on dry matter yield of *Asystasia intrusa* was studied. The treatments involved the use of planting materials, which consist of seed, seedling and stem cutting, together with planting distances of 5, 8 and 16 cm. The study showed that *A. intrusa* can be planted either by seed, seedling, or stem cutting. Though planting by seedling consistently produced high yield of 8.5 t/ha dry matter at all planting distances, planting by stem cutting produced the highest yield of 9.1 t/ha per cutting at establishment period of 18 weeks. This level of yield for stem cutting and seedling was significantly different (p <0.05) than 6.0 t/ha obtained by seed growth.

In general, planting distance of 5 cm is adequate for planting *A. intrusa* as it produced the highest yield of 9.4 t/ha per cutting compared to 7.9 and 6.4 t/ha when grown at longer distance of 8 or 16 cm, respectively. However, the difference was not significant. There was an interactive effect between planting material and distance on yield (p <0.08). As a result, it is advantageous to plant *A. intrusa* by stem cutting with a 5-cm planting distance as it was capable of producing 14.1 t/ha per cutting. If it can be replanted three times a year, it is postulated to produce 40.8 t/ha/year of good quality fodder. At the same time, planting distance of 8 cm is recommended when planting by seeds. *Asystasia intrusa* can also be cut initially at 18 weeks after planting.

Introduction

In forage production, planting distance has great impact on dry matter yield, which can contribute to higher income. *Brachiaria humidicola* and *Brachiaria decumbens* at 1 m x 1 m spacing give the best yield (Aminah et al. 1989). Okeagu and Agishi (1990), on the other hand, showed that planting at 20 cm x 20 cm distance gives significantly higher dry matter production than 40 cm x 20 cm and 60 cm x 20 cm for *B. decumbens*. Jayawardana (1985) recommended that, for pasture species, cuttings be planted at 30 cm x 30 cm, while 60 cm x 60 cm for fodder.

Asystasia intrusa is an introduced native species, which has the potential and capability of solving the problem of low quality forage of this country. It is a prolific weed (Rajaratnam et al. 1976; Lee 1984) growing well in both shade and open space (Suparjo et al. 1991, 1997) and has a quality similar to alfalfa (Suparjo et al. 1990). The crude protein (CP) content of the aerial part

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ranges from 194 to 320 g/kg dry matter (DM), with an acid detergent fiber (ADF) content of 216–308 g/kg depending on the light intensity and age of cutting (Suparjo, thesis under publication). It is highly palatable (Eng 1989; Tajuddin and Chong 1991) and highly digestible when consumed by rams (Mokhtar and Wong 1988) and rabbits (Suparjo 1998). Persistence of the species declines under continuous harvesting or grazing (Wong et al. 1989). Hence, it is necessary to focus on finding the method of establishment of the species for good production.

Considerable amount of research has been conducted on understanding the biology of the *A. intrusa* as a weed (Rajaratnam et al. 1976; Lee 1984; Suparjo et al. 1991). Emphasis, however, should be directed to cultivation of the species to be utilized as animal feed. The objective of this study was to define a suitable method of propagation and planting distance that would give the highest yield as soon as possible.

Materials and methods

The effect of planting material and distance on *A. intrusa* was studied in a tropical climate in MARDI, Serdang. It is located 31 m above sea level at latitude 3° 02' north and longitude 101° 42' east. The experiment began on 4 December 2001 and ended on 9 April 2002.

Three beds, each measuring 750 cm in length, were marked from a 80 cm width row running diagonally down a slope. The row was perpendicular to the path of the sun. Three planting materials, namely seed, seedling and stem cutting, were randomly applied to the beds. Before each bed was planted, it was divided to obtain three sub-plots of 80 cm x 250 cm. Each sub-plot was planted with *A. intrusa* at a planting distance of 5, 8 or 16 cm, randomly *(Figure 1)*. Guard rows were located between the main plots. The split-plot design experiment was replicated three times. Each plot was pegged with 30 cm PVC pipe and labelled using black paint.

Planting materials were all prepared fresh and collected from the vicinity of the farm. Seeds, recently collected using fine nylon netting laid 6 cm above ground in a colony of *A. intrusa*, were stored in a bottle for a few weeks. Two seeds were sown in a planting point at about 0.5 cm deep. For the next planting material treatment, seedlings of about 4–8 leaf stage were pulled and collected from nearby areas in the farm. Finally, stems of *A. intrusa* were cut 20 cm long and planted in an upright position on the same day. Only one seedling or stem cutting was used per planting point.

Maintenance of plots began as soon as sowing or planting was completed. Any points with no living plants would be replaced with new materials of the same age. When two seeds germinated, one would either be pulled out, or, used to replace points, which did not germinate.

All experimental materials were watered when the soil was dry and did not stick to the fingers. Each row was irrigated using 'Sumisansui' laser drilled sprinkler hose connected directly to a water pipe. No fertilizer was given to all the plots during experiment because *A. intrusa,* in their natural habitats, were not fertilized.

REP I	L16	L5	L8	C5	C8	C16	S5	S16	S8
REP II	S8	S5	S16	C8	C16	C5	L8	L5	L16
REP III	L8	L5	L16	S5	S8	S16	C8	C16	C5

Figure 1. Layout of plots in experimental design (L = seedling, C = stem cutting, and S = seed)

Dead seedlings or stem cuttings as planting materials would be replaced accordingly, using fresh materials from the vicinity. Weeds were regularly removed by hands.

Results

Generally, replicates 1 and 3 had a germination rate close to 100% for *A. intrusa* planted using seeds. However, only about 25% of the points in replicate 2 germinated. The rest of the planting materials, namely seedling and stem cuttings, had good growth occurrence in all the replicates.

Buds and flowers emerged three weeks after planting, while mature seeds, as well as flowers, five weeks after planting. While waiting for a majority of the pods to dehisce, a few plants began to lean and fall. It happened in taller erect plants in plots with stem cutting treatment. A decision was, therefore, made to harvest all plants at that stage of growth when they were 18 weeks old.

The type of planting material used to grow *A. intrusa* affected its dry matter yield. Stem cutting produced the highest DM yield ($p < 0.05$) with a mean of 9.1 t/ha per cutting, after extrapolation in *Table 1*, compared to a mean DM yield of 8.5 and 6.0 t/ha for respective seedling and seed as the planting material.

The dry matter yield of *A. intrusa* decreased with longer distance of planting. A planting distance of 5 cm would yield 9.4 t/ha of dry matter, compared to 7.9 and 6.4 t/ha in 8 and 16 cm, respectively.

The effect of planting distance on dry matter weight actually depended on planting material used ($p < 0.05$). In stem cutting, the yield of *A. intrusa* increased inversely with distance. It increased 50% from a mean of 5.9 to 14.1 t/ha when the planting distance was reduced from 16 cm to 5 cm *(Figure 2)*.

Growth using seedling, however, did not appear to affect yield when grown at 5, 8 or 16 cm distance. They were consistently the same. On the other hand, planting by seed at 8 cm distance increased yield, compared to either the shorter 5 cm, or, longer 16 cm distance.

Discussion

A good initial growth from all planting materials occurred in all the plots, except for the seed treatment in replicate 2. This was due to sufficient water being supplied through mist droplets supplied by the Sumisansui hose. The seeds were not washed away through erosion. However, the poor germination of seeds in replicate 2 could not be determined. Vacant points were filled by new plants as explained earlier. By the fifth week, plants in all the treatments looked fresh and leafy although no fertilizer was applied in the experiment, as usually happen in the wild.

To determine time of harvest of any fodder, the point of interception between

Table 1. Dry matter yield (kg) in a 2 m^2 area (or calculated for t/ha) of *A. intrusa* with different methods and distances of planting after 18 weeks of establishment

Distance between plants (cm)	Methods of planting							
	Seeds		Seedlings		Cuttings		Mean	
	kg/2 m^2	(t/ha)	kg/2 m^2	(t/ha)	kg/2 m^2	(t/ha)	kg/2 m^2	(t/ha)
5	1.16	(5.8)	1.67	(8.3)	2.83	(14.1)	1.88a	(9.4)
8	1.55	(7.7)	1.72	(8.6)	1.45	(7.2)	1.58a	(7.9)
16	0.92	(4.6)	1.72	(8.6)	1.19	(5.9)	1.28a	(6.4)
Mean	1.21b	(6.0)	1.71ab	(8.5)	1.82a	(9.1)	1.58	(7.9)

Distance (column) and method of planting (row) means with different letters are significantly different at $p < 0.05$

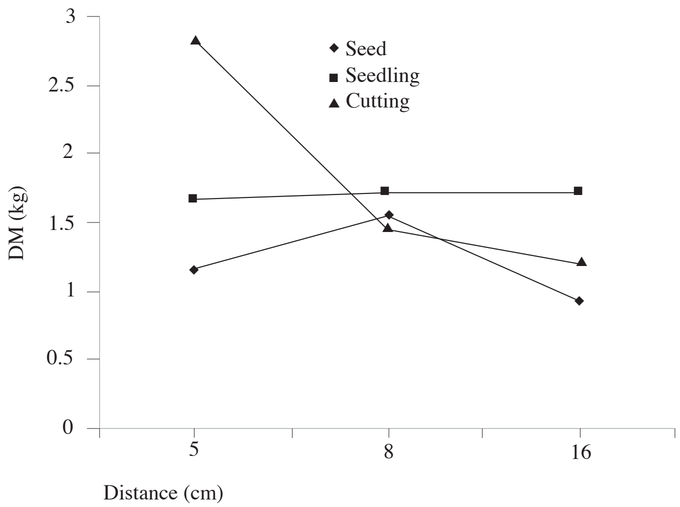

Figure 2. Differences in aerial part biomass yield of ***Asystasia intrusa*** *as influenced by planting materials and at different planting distances in a 2m² area 18 weeks after forage establisment*

yield and quality at various ages of growth is often adopted. But for practical purposes, stage of maturity is used to indicate the optimum yield and quality. In alfalfa, fodder of high quality is harvested at the early bloom stage. On the other hand, the use of agronomic description to determine stage of maturity of *A. intrusa* was difficult because, unlike alfalfa, the plant continuously produced tillers and flowers.

There is no published information on the time to harvest *A. intrusa*. Good quality fodder can probably be achieved if the cut is made at early bloom as in alfalfa. However, harvesting at early bloom stage will deprive *A. intrusa* of seeds for the regeneration of the colony.

The choice of cutting at 18 weeks was suitable for this experiment. Not only did some dehisce seeds had been dispersed, it avoided further lodging of the plants. Sagged plants were undesirable. Lots of lower leaves were lost at this stage and plants appeared stemmy. Presumably, it has lower nutritive quality. Though sagged, most of the stems did not touch the soil surface. Therefore, they had no chance to bear roots and assimilate nutrients. At the same time, any seeds available beneath the canopy could not germinate because it was too shady for germination.

When seeds were used, dry matter yield decreased in the 16-cm planting distance. Besides, more weeds were present. It is naturally so because natural seed loads already in the pasture soils which may be 5,000 to 50,000 seeds/m^2 (Jones and Evans 1977) were given the space and light opportunity to germinate. Wong et al. (1989) also reiterated that weed invasion increases with shorter cutting interval, especially at 3 weeks old.

All the three planting materials could be used for growing *A. intrusa*. However, dry matter yield potential was affected by the type of planting material used. Since seeds took time to germinate, this planting material gave the lowest dry matter yield at the 18-week-old establishment. Or, the lower seed germination in replicate 2 might have pulled down the overall yield, thus affecting the result of this treatment. An 8-cm planting distance (156 seeds/m^2) is recommended when seeds are used. It is within the recommendation that tropical pastures be sown at 100 to 700 seeds/m^2 (Humphreys 1979; Silcock 1980). A higher seeding rate can be used in higher rainfall areas to provide a quicker cover, thus suppressing weed growth (Skerman 1977). As high as 370 plants/m^2 had been noted in *A. intrusa* by Lee (1984). Dry matter yield of *A. intrusa,* however, was lower in the 5 cm planting distance in this experiment.

The seedlings treatment consistently produced high yield in all the planting distance. From the interactive effect, it is advantageous to plant *A. intrusa* by stem cuttings at a 5-cm planting distance. The treatment yielded 14.1 t/ha of dry matter per 18-week period during establishment. It is too early to postulate annual yield based on the current trial because plants lose its vigour and die with time. Nevertheless, the establishment yield is a good indicator of growth vigour from the different planting materials.

Seeds take time to germinate and grow. Seedlings have faster growth, while stems are slow. It is important to see the rate of regrowth in these planting materials after first harvest. For this purpose, a report will be published later.

A shift in paradigm on production of high quality feed in large quantity is necessary. If *A. intrusa* can be replanted three times a year, a predicted amount of 40.8 t/ha dry matter will be produced with adequate irrigation using stem cuttings with 5 cm planting distance. Therefore, the normal way of utilizing fodder regrowth for four or five years cannot be applied for *A. intrusa*. This plant has to be harvested and replanted after every 18 weeks, just like the way farmers plant and harvest carrots, for example.

Though the assumption looks good, in reality the cost may be prohibitive for it to be justifiable. This perspective is not impossible after considering the quality and yield of fodders available in this country. *Pennisetum purpureum* and *Panicum maximum*, the most popular forages in the country for their yield and persistence, produce between a mean of 16.1–22.7 t/ha/yr and 14.1–21.0 t/ha/yr (Wan Hassan et al. 1990) at different ages of cutting for a period of three years, respectively. In another experiment, *P. purpureum* produces a DM yield of 52.3 t/ha/yr when cut at 8 weeks interval in the first year of growth (Wan Hassan 1987).

Considering the high nutrient quality of *A. intrusa*, the potential of the species as fodder is therefore great. The country, as in other tropical countries, does not lack having species that is high yielding. Rather, it lacks high quality species. Therefore, a high nutrient quality species like *A. intrusa* accompanied by its high dry matter yield will be a big boost for the development of livestock industry in this country.

The outcome from the extrapolation was rather unbelievable. It suggested that more field research should be conducted on *A. intrusa,* preferably on a slightly larger scale to support the findings.

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Abstrak
Kesan bahan dan jarak tanaman terhadap pengeluaran bahan kering rumput *Asystasia intrusa* telah dikaji. Perlakuan yang diguna dalam kajian ini ialah bahan tanaman yang terdiri daripada biji, anak benih dan keratan batang, serta jarak tanaman pada 5, 8 dan 16 cm. Kajian mendapati *A. intrusa* boleh ditanam menggunakan biji, anak benih dan keratan batang. Walaupun penggunaan anak benih sentiasa mengeluarkan hasil yang tinggi dan konsisten sebanyak 8.5 t/ha, menanam dengan keratan batang memberi hasil paling tinggi, iaitu 9.1 t/ha bahan kering sekali potong dalam masa 18 minggu penubuhannya. Aras hasil daripada kedua-dua keratan batang dan anak benih ini berbeza dengan bererti (p <0.05) berbanding dengan hasil daripada biji, iaitu 6.0 t/ha.

Pada amnya, jarak tanaman 5 cm sesuai untuk menanam *A. intrusa*. Pada jarak ini, tanaman boleh menghasilkan 9.4 t/ha sekali potong berbanding dengan 7.9 dan 6.4 t/ha masing-masing pada jarak tanaman 8 dan 16 cm. Sungguhpun begitu, perbezaannya tidak bererti. Terdapat tindak balas antara bahan tanaman dengan jarak tanaman terhadap hasil (p <0.08). Sehubungan dengan itu, amatlah berfaedah menanam *A. intrusa* menggunakan keratan batang pada jarak 5 cm kerana ia berupaya mengeluarkan hasil 14.1 t/ha sekali potong. Pada unjuran menanam semula tiga kali setahun, keratan batang pada jarak 5 cm boleh mengeluarkan 40.8 t/ha setahun foder yang bermutu tinggi. Pada masa yang sama, jarak 8 cm adalah disyorkan jika menanam dengan biji. Juga, *A. intrusa* boleh dipotong 18 minggu selepas ditanam.

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