Purity study of imported leguminous cover crops

Arifin Tasrif, Ismail B. Sahid, S.S. Sastroutomo[1] and **A. Latiff**.
Botany Department, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia.
[1]ASEAN–PLANTI, Serdang, Selangor, Malaysia.

Summary

Weed seeds in imported leguminous cover crop seed were screened in the laboratory while weed distribution was surveyed in selected plantations in Selangor, Malaysia. Thirty-five samples from each of five species of imported leguminous cover crop seeds; namely *Calopogonium mucunoides* Desv., *Calopogonium caeruleum* Sauv., *Centrosema pubescens* Benth., *Mucuna cochinchinensis* Baker. and *Pueraria javanica* Benth. were analyzed for purity. The study has shown that all samples were contaminated with weed seeds. However, the percentage of weed seeds was below maximum tolerance limit of 0.5%. Twenty–nine species of weed seed were identified in these samples. Seeds of *Cassia tora* L., *Ageratum conyzoides* L., *Eleusine indica* (L.) Gaertn. and *Cynodon dactylon* (L.) Pers. were most frequently found. Germination and viability tests using tetrazolium chloride showed that most weed seeds were viable. For example, the viabilities of *Bidens pilosa* L., *Hyptis capitata* Jacq. and *Eclipta alba* Hassk. were 93, 91 and 89% respectively. The number of weed seed in the *C. mucunoides* sample was high at an estimated 137 weed seeds per kilogram.

Most of the weed seeds found in leguminous cover crops belonged to the Leguminosae. There were 61 weed species observed growing among leguminous cover crops. Five weedy species, namely *Aeschynomene indica* L., *Cynodon dactylon* (L.) Pers. *Melochia corchorifolia* L. *Oryza* sp. and *Synedrella nudiflora* L. were found in imported cover crop seed but were not observed in rubber and oil palm plantations in Selangor. *Asystasia intrusa* Bl. and *Axonopus compressus* (Sw.) Beauv. were the most commonly found in both plantations but seeds were not detected in the imported legume cover crop seed. The SDR value of *A. intrusa* in young rubber and oil palm plantations was higher than other weed species at 18.4 and 22.4% respectively.

Introduction

Establishment of leguminous cover crops in young rubber and oil palm plantations is common practice in Southeast Asia (Sastroutomo 1987, Lim and Infante 1988). The practice prevents soil erosion, suppresses weed growth and improves soil nitrogen status (Pushparajah 1977).

In Malaysia, approximately 2700 tonnes of leguminous cover crop seed is imported per year from countries such as Thailand, Indonesia, Sri Lanka and India because local production cannot supply enough seed. In 1982, approximately 245,000 ha of oil palm and rubber estates in the Malaysian Peninsular were planted with leguminous cover crops (Yeoh and Phang 1980, Ngizailah and Nair 1985).

Consignments of leguminous cover crop seed are often contaminated with weed seeds. During 1984 to 1987, a total of 43 weed species, some previously unrecorded in Malaysia, such as *Convolvulus sevium* L. and *Cannabis sativa* L. were detected in imported seed (Ngizailah and Nair 1985, Sastroutomo 1987). From a plant quarantine point of view, continuous screening of imported leguminous cover crop seeds and of weed floras in plantations is needed to prevent the establishment of noxious weeds. The aim of this study is to analyze the purity of imported cover crop seeds and the survival of weed seeds under field conditions.

Materials and methods

Sample sources

Thirty–five samples of five species of leguminous cover crops, *C. caeruleum, P. javanica, C. pubescens, M. cochinchinensis* and C. *mucunoides* were analyzed. Samples were obtained through an importing agent at Kuala Lumpur in l989.

Purity Analysis

Samples were separated, using a straight–edged spatula, into pure seeds, other crop seeds, inert matter and weed seeds. The sample weight was equivalent to 25,000 seeds or ten fold that required for purity analysis (ISTA 1976). Sample size of seed used were *C. caeruleum* 500 g; *C. mucunoides,* 300 g; *C. pubescens,* 500 g; *M. cochinchinensis,* 500 g; and *P. javanica,* 250 g.

Germination test

Isolated weed seeds were identified and their viability tested by germination in petri dishes and by using 2,3,5 tetrazolium chloride (TTC). Twenty seeds were placed on two sheets of Whatman No. 2 filter paper in a 9 cm petri dish. The filter paper was moistened with 5 ml distilled water. Germination tests were conducted at 27ºC for 12h dark / 12h light (175 µE. m^{-2} s^{-1}). Germination was assessed at 2 day intervals for 14 days. Seeds were considered germinated when the radicle attained 1 mm or more of length.

Viability of ungerminated seeds was determined using TTC. The embryos of viable seeds stained pink to red after TTC treatment. Percent viability was expressed as the sum germinated plus viable seeds detected by TTC, divided by the total number of seeds examined. A complete randomized design with five replications was used for the laboratory experiments.

Weed composition in rubber and oil palm plantations.

Observations of the weed flora among leguminous cover crops were carried out at the Rubber Research Experimental Station, Sungai Buloh (rubber plantation) and the Prang Besar Research Station (oil palm plantation) at Kajang, Selangor. Observation were made in 2 m × 2 m plots between January and December 1990. Ten plots were selected randomly in each growth stage, (young, matured and old) of either rubber or oil palm. All species of weeds were counted and sampled for subsequent identification. Summed Dominance Ratio (SDR) of species was determined from the sum of relative density, relative frequency and relative dominance (Numata 1982, Utomo *et al.* 1984, Sastroutomo and Pandegirot 1988).

Results

Purity analysis

Table 1 shows the components of purity analysis represented as percentage by weight. *M. cochinchinensis* had the highest percentage of pure seeds (99.76%), while the pure seed content of the other species exceeded 99%. The percentage of other crop seeds ranged from 0.04–0.15 %. C. *mucunoides, P. javanica* and *C. pubescens* contained inert matter between 0.4% and 0.5%. *M. cochinchinensis* contained the least inert matter.

About 0.001% of weed seed was found in the *M. cochinchinensis* sample. For *C. caeruleum, C. pubescens* and *P. javanica* the percentage of weed seeds was 0.01, 0.02 and 0.02% respectively. The weed seeds content in *C. mucunoides* was the highest at 0.1%. with 137 weed seeds per kilogram representing 13 weed species. It was followed by *C. pubescens* (from Sri Lanka) and *P. javanica* (from the Philippines) which contained 60 and 57 weeds seeds per kilogram, respectively. More species were represented in the samples of *C. pubescens* with 22 species of weeds. *M. cochinchinensis* was the cleanest among the cover crops studied with 22 seed per kilogram representing only six species.

Weed seeds detected in imported cover

Table 1. Purity analysis of imported leguminous cover crops

Species	Country	Percentage (by weight)				Weed seeds (Kg^{-1})	No. of species
		Pure seeds	Other seeds	Inert matter	Weed seeds		
Calopogoniun mucunoides	Sri Lanka	99.54	0.15	0.21	0.10	137	13
Calopogoniun caeruleum	Sri Lanka	99.50	0.07	0.42	0.01	45	12
Centrosema pubescens	Sri Lanka	99.50	0.04	0.44	0.01	60	22
Pueraria javanica	Philippines	99.50	0.04	0.44	0.01	57	8
Mucuna cochinchinensis	Indonesia	99.70	0.08	0.15	0.00	22	6

Table 2. Number of weed seeds and their viabilities intercepted in legume cover crop seeds.

Weed species	Number of seeds	Seeds as % of total	Viability (%)
CAPPARIDACEAE	(12 seeds)		
Cleome rutidosperma DC.*	12	1.93	42
COMPOSITAE	(182 seeds)		
Ageratum conyzoides L.	96	15.43	42
Bidens pilosa L.	30	4.82	93
Chromolaena odorata K.&R.	24	3.86	17
Eclipta alba Hassk.	28	4.50	89
Mikania micrantha H.B.K.*	2	0.32	0
Synedrella nudiflora L.*	2	0.32	50
CYPERACEAE	(20 seeds)		
Cyperus iria L.	20	3.22	50
GRAMINEAE	(125 seeds)		
Cynodon dactylon (L.) Pers.	41	6.60	19
Eleusine indica (L.) Gaertn.	63	10.13	42
Paspalum conjugatum Berg. *	16	2.57	20
Oryza sp. *	5	0.80	80
LABIATAE	(33 seeds)		
Hyptis capitata Jacq.	33	5.31	91
LEGUMINOSAE	(223 seeds)		
Aeschynomene indica L.*	15	2.41	13
Cassia mimosoides L.	26	4.18	38
Cassia tora L.	120	19.30	71
Crotalaria mucronata Desv. *	6	0.96	83
Crotalaria striata L.*	1	0.16	100
Mimosa invisa Mart.	23	3.70	60
Mimosa pudica L.	30	4.82	63
Leguminosae (other species) *	2	0.32	0
MALVACEAE	(14 seeds)		
Sida rhombifolia L.*	10	1.61	30
Urena labota L.*	4	0.64	50
RUBIACEAE	(1 seed)		
Borreria alata (Aubl.) DC. *	1	0.16	0
STERCULIACEAE	(3 seeds)		
Melochia corchorifolia L.*	3	0.48	67
UMBELLIFERAE *	1 (seed)	0.l6	0
VERBENACEAE	(4 seeds)		
Stachytarpheta indica L.*	4	0.64	75
Unidentified family	(4 seeds)		
Species 1 & 2	4	0.64	–
Total	**622**	**100.00**	**–**

* single replicate

crops

Seeds belonging to 29 species of weeds were found in the five different cover crops (Tab1e 2). The most common weed seeds were *C. tora* (120 seeds), *A. conyzoides* (96 seeds), *E. indica* (63 seeds) and *C. dactylon* (41 seeds). A total of 622 weed seed were detected in 33 samples. In general, the most common weed seeds in cover crop seed belong to Leguminosae (223 seeds) followed by Compositae (182 seeds), Gramineae (125 seeds), and Labiatae (33 seeds).

These seeds showed a very high viability. For instance, the viabilities of *B. pilosa, H. capitata, E. alba, C. tora, Crotalaria mucronata* Desv. and *Stachytarpheta indica* L. were more than 50%. *B. pi1osa* and *H. capitata* had the highest germination at 93 and 91% respectively. Some species such as *Mikania micrantha* H.B.K. and *Borreria alata* (Aubl.) DC. and two unidentified species of Leguminosae and Umbelliferae were not viable (Table 2.). The most common weed seeds were *C. tora, A. conyzoides* and *E. indica* at 19.3%, 15% and 10.4% respectively of total seed weight. The percentage of other weed seeds was less than 10%.

Weed flora composition in rubber and oil palm p1antations

Sixty–one species of weeds were observed growing among the leguminous cover crops under rubber and oil palm plantations. The most dominant weeds were *A. intrusa, A. conyzoides, B. alata, Cleome rutidosperma* DC., *Chromolaena odorata K.&R., M. micrantha* and *Paspalum conjugatum* Berg. (Table 3). Seeds of these species, with the exception of *A. intrusa,* were found in cover crop seed during the screening experiment. *A. intrusa* was the most dominant species compared to other weeds in either oil palm or rubber plantations. The SDR value for *A. intrusa* in young oil palm and rubber plantations was 18.4 and 22.4% respectively. *P. conjugatum* was dominant in young oil palm plantations with SDR value 11.0%. The highest SDR values for *B. alata, C. rutidosperma* and M. *micrantha* were 12.2, l0.8 and 7.0% respectively.

Discussion

Seed for legume cover crops to be planted must meet a high standard. Purity must meet or exceed 98%, inert matter must be less than 1% and other crop seeds and weed seeds must be less than 0.5% (SIRIM 1976, Anon 1987). The results indicated that all samples were within the tolerance level allowable.

Twenty–nine different species of weed seeds contaminated the samples of five species cover crop. Most are commonly found in Malaysian plantations with the exception of *A. indica. C. dactylon, M. corchorifolia, Oryza* sp. and *S. nudiflora.* All

Table 3. SDR values of weed flora composition in leguminous cover crops in rubber and oil palm plantations.

Weed species	oil palm			rubber		
	young	mature	old	young	mature	old
ACANTHACEAE						
Asystasia intrusa Bl.	18.41	12.67	9.48	22.43	13.73	18.02
Asystasia coromandeliana Ness.	–	–	–	–	–	1.28
ADlANTACEAE						
Adiantum latifolium Lamarck.	–	–	1.81	–	–	–
Taenitis blechnoides (Willd.) Sw.	–	–	l.65	–	–	–
AMARANTHACEAE						
Amaranthus gracilis Desf.	–	–	–	5.54	–	–
CAPPARIDACEAE						
Cleome rutidosperma DC.*	4.72	7.03	0.39	l0.89	8.78	2.05
COMPOSITAE						
Ageratum conyzoides L.*	2.42	7.49	5.72	6.86	18.11	3.94
Bidens pilosa L.*	–	–	–	0.09	–	–
Crassocephalum crepidioides Moore	3.29	2.62	2.92	6.13	0.50	4.04
Chromolaena odorata K. & R.*	1.12	0.56	1.03	–	1.58	l.06
Eclipta alba (L.) Hassk.*	–	–	–	–	0.26	–
Erigeron canadensis L.	3.55	0.33	–	–	–	–
Mikania micrantha H.B.K.*	7.09	4.17	l.03	0.28	9.21	4.15
Vernonia cinerea (L.) Ness.	–	–	0.37	–	0.96	l.56
CYPERACEAE						
Cyperus aromaticus K. & K.	–	–	–	–	0.96	–
Cyperus iria L.*	–	–	–	0.57	–	–
Cyperus pilosus Vahl.	–	–	–	0.75	–	–
Cyperus rotundus L.	l.58	1.72	2.35	9.04	9.05	l.56
Fimbristylis miliacea Vahl.	–	–	–	0.43	–	–
Scleria leavis L.	6.50	1.47	–	–	–	–
DENNSTAEDTIACEAE						
Davallia denticulata (Burm.) Mett.	–	–	1.41	–	–	–
Nephrolepis biserrata (Sw.) Schott	4.46	3.23	14.97	–	–	–
EUPHORBIACEAE						
Croton hirtus L.Herit.	2.88	5.82	3.14	–	0.21	2.79
Euphorbia heterophylla L.	–	1.45	–	–	–	–
Euphorbia hirta L.	–	–	–	1.26	0.79	–
Phyllanthus niruri L.	–	–	0.72	–	l.08	–
GLEICHENIACEAE						
Dicranopteris linearis (Burm. f.). Underw.	1 90	–	–	–	–	5.76
GRAMlNEAE						
Axonopus compressus (Sw.) Beauv.	4.82	4.72	5.56	1.40	5.43	0.82
Brachiaria paspaloides (Presl.) Hubb.	–	–	–	0.31	–	–
Centotheca lappacea (L.) Desv.	1.37	1.56	3.63	–	0.28	–
Dactyloctenium aegyptium (L.) Beauv.	–	–	–	0.69	–	
Digitaria adscendens Henr.	–	–	–	1.18	0.28	–
Digitaria ciliaris (Retz.) Koel.	1.76	0.39	–	2.91	0.90	–
Echinochloa colona Link.	–	0.70	–	–	–	–
Eleusine indica (L.) Gaertn.*	3.08	4.67	–	2.08	3.15	–
Ottochloa nodosa (Kunth) Dandy.	2.32	2.40	–	2. 69	–	0.42
Panicum trigonum Han.	2.49	–	1.65	–	1.28	0.44
Pennisetum purpureum Schumach.	–	–	–	3.31	–	–
Paspalum conjugatum Berg.*	11.00	9.94	5.30	3.70	10.40	4.95
Paspalum scrobiculatum L.	2.64	2.19	–	1.01	2.76	4.96
Rhynchelytrum repens . (Willd.) Hubb	–	0.60	–	1.01	–	3.87
LABIATAE						
Hyptis capitata Jacq.*	–	1.02	1.60	–	–	–
LEGUMINOSAE						
Cassia mimosoides L.*	–	–	–	–	1.13	–
Cassia tora L.*	–	2.89	–	–	–	–
Crotalaria mucronata Desv.*	–	0.33	1.29	–	–	–
Crotalaria striata L.*	–	–	–	–	–	–
Mimosa invisa Mart.*	–	0.58	–	–	–	2.44
Mimosa pudica L.*	–	2.63	1.06	–	1.17	1.68

cover crop seeds were imported from countries which have similar climatic conditions to Malaysia. These weeds all have a wide distribution and can be found elsewhere in the region.

Among the weed seeds frequently found in the samples were *A. conyzoides C. tora, C. iria, E. indica, Mimosa pudica* L. and *P. conjugatum*. Three species, C. *tora, E. indica* and *P. conjugatum* are considered to be serious weeds in Malaysian plantations (Moh. Hidzir 1986). C. *odorata, M. micrantha* and *Crotalaria* spp. are already troublesome in Malaysia and seeds of these species were detected in the imported cover crops. *C. tora* L. is considered a noxious weeds in Fiji (Mune and Parham 1967), a country with similar climatic conditions to Malaysia. Therefore, there is a chance that this species will establish in this country.

Even though the percentage of pure seeds reaches an acceptable level the number of weed seeds contaminating the cover crop seeds is considered high. C. *mucunoides* which has small seeds and is a main component of cover crop mixtures contained more weed seeds than cover crops with larger seeds, i.e. *M. cochinchinensis, C. caeruleum* and C. *pubescens*. This indicates that the seed cleaning process is more effective when seeds are large, implying a greater need for vigilance when dealing with small seeds. The danger of foreign weeds being noxious to our agriculture is not immediately obvious as cover crops can easily suppress their growth. The fact that most of these seeds are viable and able to proliferate under favourable conditions is a matter of general concern.

The most dominant weed seeds intercepted in cover crop belonged to Leguminosae as do the cover crops. This is not surprising since many weeds grow in close association with crops competing for the same nutrient and ecological niche. For instance *Echinochloa crus-galli* L. occur wherever rice is grown and is a weed of major importance in that crop (Radosevich and Holt 1984). Mimicry between weed and crops may also due to similar nutrient or environment requirement so that growth and reproduction of the weed matches the life cycle of the crop. Furthermore, although some mimics are related taxonomically to their crops, many others are not. For example, *A. intrusa* (Acanthaceae) was a dominant species growing together with cover crops in either oil palm or rubber plantations.

There were 61 species of weed observed growing in both oil palm and rubber plantations studied. Twenty of them have been detected during the screening of the cover crop seed. The most common weeds found growing together with cover crop in either rubber or oil palm plantations were *A. conyzoides, A. intrusa, B. alata, C. odorata, C. rutidosperma, M. micrantha,*

Table 3 continued from previous page

MALVACEAE						
Sida rhombifolia L.*	–	0.64	2.09	–	–	0.41
Urena lobata L.*	–	0.64	2.56	–	–	–
MELASTOMATACEAE						
Clidemia hirta Don.	1.14	2.17	8.81	–	0.33	0.43
Melastoma malabathricum L.	–	3.27	3.50	4.88	1.02	3.69
PASSIFLORACEAE						
Passiflora foetida L.	–	–	–	–	0.34	–
RUBIACEAE						
Borreria alata (Aubl.)DC.*	12.21	10.09	3.59	3.45	2.24	3.26
Borreria hispida L.	–	0.34	9.92	–	–	–
Mitracarpus scaber Zucc.	–	–	–	2.59	3.22	0.39
SCROPHULARIACEAE						
Scoparia dulcis L.	–	–	0.23	2.83	–	0.57
THELYPTERIDACEAE						
Cyclosorus aridus (Don) Ching.	–	–	–	–	–	0.64
VERBENACEAE						
Lantana camara L.	–	–	–	–	–	11.25
Stachytarpheta indica Vahl.*	–	–	–	–	–	l.45
VITACEAE						
Cayratia japonica (Thunb.) Gagnep.	2.80	–	2.19	–	–	l.6l

– = not present
* = detected in leguminous cover crops

and *P. conjugatum*. *A. intrusa* can be found in oil palm or rubber plantations of different growth stages. This is the most dominant weed with the range of SDR value between 9.48 to 22.43%. However, the seeds of *A. intrusa* were not found in any of the samples and previous reports have shown that *A. intrusa* seeds have never been isolated from cover crops (Ngizailah and Nair 1985, Sastroutomo 1987). The occurrence of *A. intrusa* in the field may be explained by other forms of seed dispersal such as the movement of machinery. It is strongly suspected that the poly–bags used for oil palm seedlings were the primary source of the initial population of the weed.

Many noxious weed seeds have been introduced into plantations unconsciously but have not established. *C. tora* seed was the most common in seed samples but can only be observed in mature oil palm plantations. The danger of foreign weeds to our agriculture is not immediately obvious but in the long run it is possible that these weeds may invade other annual crops.

Therefore, in the best interest of agriculture it is not sufficient just to quarantine against pest and diseases. Attention should be given to the possible introduction of noxious weeds through seed consignments. It is recommended that samples of seeds be taken from all seed consignments at every entry point for purity analysis.

Acknowledgement
Acknowledgement is made to ASEAN–PLANTI for a research studentship for Arifin Tasrif.

References

Anonymous (1987). Report of the Meeting on Standardization for Weed Interception. 30 Sept – 2 Oct. l987. Manila. Philippines.

ISTA–International Seed Testing Association. (1976). International rules for seed testing. Seed Science Technology 4, 1–180.

Lim, C.G. and Infante C.S.(1988). Detection of seed borne fungi in imported cover crop seed and treatments. Proc. Symp. Introduction of Germplasm and Plant Quarantine Procedures (A.W. Jalil *et al.* Eds.). ASEAN–PLANTI, Malaysia. pp. 305–15.

Ngizailah, Z. and Nair, J. (1985). Weed seeds and other contaminants in cover crop seeds imported into Peninsular Malaysia and their quarantine implication. *Journal of Plant Protection in the Tropics* 2 (1), 53–9.

Moh. Hidzir Abd. Kadir. (1986). Present status of weeds and their control in Malaysian agriculture. SEAMEO–BIOTPOP. Bogor, Indonesia. pp. 56–67.

Mune, T.L. and Parham, J.M. (1967). The declared noxious weeds of Fiji and their control. Suva Government of Fiji.

Numata, M. (1982). A methodology for the study of weed vegetation. In: Biology and Ecology of Weeds (W. Holzner and M. Numata Eds.). Dr. W. Junk Publishers. London. pp. 21–2.

Pushparajah, E. (1977). Weed control in legume covers. Lectures Note 36. Fifth BIOTPOP Weed Science Training Course. Rubber Research Institute of Malaysia (RRIM), Kuala Lumpur, Malaysia. pp. 1–8.

Radosevich, S.P. and Holt, J.S. (1984). 'Weed Ecology: Implication for Vegetation Management.' John Wiley & Sons. N. York.

Sastroutomo, S.S. (1987). Germination and viability of weed intercepted from cover crop seeds. Proceedings of the Symposium Movement of pest and control strategies. (Singh, K,G, *et al.*, Eds. ASEAN–PLANTI, Malaysia. pp. 169–78.

Sastroutomo, S.S. and Pandegirot, E.T. (1988). Survai ekologis gulma di perkebunan "Ciliwung" Jawa Barat. In: Pros. Komp. HIGI Ke–9. (S. Tjitrosoedirjo *et al.*,. Eds.). Vol. 2, 223–53.

SIRIM–Standards and Industrial Research Institute of Malaysia.(1976). Specification for leguminous cover crop seed for planting. Malaysian Standard No. 3.

Utomo. I.H., Tjitrosoedirdjo, S. and Wiroatmojo, J. (1984). Pengelolaan gulma di perkebunan. Gramedia Jakarta.

Yeoh, C.H. and Phang, K. (l980). Legume cover in rubber plantations. Proceedings – Legume in the Tropics. Universiti Pertanian Malaysia. pp.425–32.