THE PRESENT STATUS AND FUTURE DIRECTION OF WEED SCIENCE IN MYANMAR

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INTRODUCTION

Myanmar is an agricultural country bordering with China, Thailand, India and Bangladesh. Administratively, it is divided into seven states and seven divisions (Fig. 1) which can be grouped into four agro-climatic zones based on rainfall and temperature (Fig. 2). These are; i) Hot and humid zone of the delta and coastal strip, ii) Central hot, dry zone, iii) Cold, dry zone of the Shan hilly region and, iv) Cold and humid zone of the northern mountainous region.

Myanmar has two distinct climates, the wet season with an average rainfall of 2,500 mm from May to October, and the dry season during the rest of the year. December to early February are the coldest months while March and April are hot and dry months. The rest of the year has a mild temperature but generally wet.

Myanmar has a total land area of 67.7 M ha, of which only 8.0 M ha is cultivated to annual crops, 2.0 M is fallow and 8.6 M remains uncultivated (Table 1). The major crops grown are rice, maize, sesame, peanut, legumes, sunflower, sugar cane, cotton and jute. Crops yields are relatively low (Table 2) due to some production constraints. Weeds are one of the constraints and are more pronounced in the upland ecosystem than in the lowland area (Aye Swe, *et al.*, 1991). As reported earlier yield loss of upland rice can be as much as 40% (Ler Wah, 1991).

This paper reviews present status and future direction of weed science in Myanmar and its importance in crop production.

Table 1. Mean annual land use in Myanmar (1985-90)*

Kind	Area (000 ha)
Net sown area	8,011
Fallow land	2,048
Cultivable waste	8,642
Reserved forests	10,076
Other forests	22,301
Other land	16,787
Total	67,687

*Data from the Review of the Financial, Economic and Social conditions for 1989/90, Ministry of Planning and Finance.

WEEDS IN CROP PRODUCTION

To know the magnitude of weeds problem, 480 surveys were conducted in 1986-88 by MAS plant protection group of Extension Division in lowland rice area. In general, it was observed that more than 80% of the fields were infested with weeds and 15% of them reached economic threshold levels (ETL) (Fig. 3). In this study the ETL was established based on weed population in each group, occurring at each growth stage of the rice plant (Table 3). This survey also

Table 2. Yield comparison of some major crops of Myanmar with its neighbours (1981-82)

Crop	Yield (kg/ha)			
	Myanmar	India	China	Thailand
1. Rice	2,941	1,744	4,607	1,862
2. Wheat	1,334	1,696	2,283	-
3. Maize	1,466	1,121	3,199	2,033
4. Sorghum	514	675	2,857	1,042
5. Peanut	1,032	757	1,549	1,176
6. Sesame	232	188	376	731
7. Sunflower	762	575	1,224	-
8. Jute	971	1,023	4,075	1,042
9. Cotton	1,047	490	1,727	1,052
10. Sugarcane	54,271	57,535	58,187	52,872
11. Pulses	723	468	1,244	695
12. Potato	8,520	13,750	10,338	11,290
13. Tea	874	1,527	307	-
14. Coffee	450	650	932	634

showed that grasses were more problematic than broadleaved and sedges in lowland rice production. Level of weed infestation differed among locations depending upon the meteorological and geographical conditions. About 100% of the field surveyed in the hilly regions were infested with weeds and received lower and erratic rainfall. In these areas there is water stress and drought condition which pronounced the deleterious effects of weeds on the crops performance (Fig. 4 and 5). Consequently the percentage of areas having ETL was also high. In places, where rainfall has been adequate and proper water management was possible, weeds were less threatening, but there is also infestation (Fig. 6). The harmful effects of different weeds can be observed in the reduction of rice yield which is lower in hilly and drier regions when compared to that in Yangon, Bago, Ayeyarwady and Mandalay Division (Fig. 7).

Because of low and declining rice yield and in order to identify appropriate research issues, a diagnostic survey was conducted by a team of agricultural scientists from CARI and IRRI last July in four townships in Myanmar (Aye Swe, *et al,* 1991). Findings indicated that weed is not a serious problem in rainfed lowland rice production in general although contributed to rice yield reduction in the upper fields in the toposequence (Table 4).

Table 3. Number of weeds per 0.36 m^2 at different crop stages as economic threshold level on rice in Myanmar, 1987 (From Plant Protection Group)

Kind of weeds	Crop Growth Stages				
	I	II	III	IV	V
Broadleaves	-	10	15	15	-
Grasses	-	15	20	20	-
Sedges	-	5	10	10	-

I= Seedling; II = Tillering; III = Stem elongation + Booting; IV = Heading + Flowering; V = Milk to Maturity

Table 4. Farmers rice production problems, farmers solution, and team suggested rice research. Hlegu, WS, 1991 (From Aye Swe, et al, 1991)

Problem	Farmer solution & Needed Research
1. Lack Labor for TPR harvest	- FARMER SOLUTIONS: wet seed rice - SUGGESTION: further study farmer practice
2. Lack of fertilizer	- FARMER SOLUTIONS: wet seed rice - SUGGESTION: soil sampling and analysis, crop cuts in farmers' fields to determine yield differences under WSR, TPR, w/, w/o fertilizer
3. Stemborer, cutworm, caseworm	- FARMER SOLUTIONS: usually do not spray - SUGGESTIONS: crop loss assessment
4. Poor wsr crop establishment	- FARMER SOLUTIONS: fill gaps from nursery - SUGGESTIONS: cultivar testing
5. Flooding	- FARMER SOLUTIONS: repeat wsr or change to tpr on same field - SUGGESTION: test dsr (although many problems would be associated with it)
6. Weeds in upper fields	- FARMER SOLUTIONS: tpr - SUGGESTIONS: crop loss assessment

Table 5. Research ranked upland rice problems, Angban & Kyaukme, WS 1991 (From Aye Swe, *et al*, 1991)

Problem	Aungban	Kayukme
Weeds	1	2
Soil fertility/expensive fertilizer	2	3
Insect pests	2	-
Soil erosion	2	-
Poor crop establishment	5	-
Drought	6	1
Reduced fallow duration	-	4

In upland rice production, however, weed is a serious problem which is one of the causes of low rice yield unless it is properly controlled (Table 5).

STATUS OF RESEARCH ON WEEDS

Weed science is not new in Myanmar but much attention is given very lately. A number of weed control experiments were conducted since early 1970 (Aung Myint, 1979; San Thein, 1983; Mar Mar Kyu, 1989). Those of San Thein and Mar Mar Kyu (1989) were focused on chemical weed control on lowland and upland rice while those of Aung Myint (1985) stressed on chemical control in rice, cotton, and peanut.

Weed science section was first established in 1985 at the Botany Division of CARI. It was later transferred to Entomology Division since its main function falls under the category of crop protection. Its main initial activity was

Table 6. Effect of weeding time on the number of pods, branches and pod yield (Yezin, 1987)

Treatment	Pods per plant	Branches per plant	Pod yield (kg/ha)	% Yield loss
Weedy	15.7 ab	6.13 ab	789 a	51.16
Conventional Method	15.1 ab	7.68 b	1,235 c	24.41
Weeded bt 7-84 DAE	18.1 cd	7.20 b	1,634 d	0.00
Weeded bt 7-30 "	16.2 bcd	8.10 b	1,420 cd	13.09
Weeded bt 7-64 "	20.5 d	7.78 b	1,608 d	1.59
Weeded bt 44-64 "	10.5 ab	5.97 ab	1,144 bc	29.98
Weeded bt 44-84 "	13.1 abc	5.88 ab	1,296 c	20.68
Weeded at 30 DAE	14.1 abc	5.90 ab	926 ab	43.32
Weeded at 63 "	10.3 a	4.10 a	926 ab	43.32
LSD		**	*	**
CV (%)	13.5	21.2	15.7	

Means followed by same letters are not significantly different by DMRT
* = Significantly different at 5% level
** = Significantly different at 1% level

Table 7. Effect of weeding time on peanut yield, Yezin 1989

Treatment		Peanut Yield (kg/ha)	Yield loss (%)
Weeded	0 - 1 week	430.78 bc	56.31
"	0 - 2 "	349.78 cd	64.52
"	0 - 3 "	350.93 cd	64.41
"	0 - 4 "	565.83 b	52.61
"	0 - 5 "	610.15 b	38.02
"	0 - 6 "	815.08 a	17.33
"	0 - 7 "	886.53 a	10.09
"	0 - 8 "	974.75 a	1.14
Weed-free		985.98 a	0.0
Weedy		214.35	78.26
	LSD (0.05)	174.52	
	CV (%)	19.49	

Means followed by the same letters are not significantly different by DMRT

Table 8. Yield loss assessment in rice and blackgram at CARI, Yezin (1988-89)

Weed Control Method	Yield (kg/ha) TPR	WSR	Blackgram
	(1988)	(1988)	(1989)
Unweeded	1,975 (30)	2,779 (10)	625 (40)
Conventional	2,837 (-)	2,767 (11)	962 (7)
Weed-free	2,825 (-)	3,096 (-)	1,037 (-)
Weeded early Season	2,225 (21)	2,719 (12)	1,162 (-)
Weeded Early & Mid-Season	2,712 (4)	3,171 (-)	-

TPR = transplanted rice; WSR = wet seeded rice

weed collection and identification but in 1987, with only one researcher and few laborers, the activities expanded in the area of weed science particularly on weed control studies, yield loss assessment and field experimentation.

MAJOR FINDINGS

1. Yield loss assessments

This study was carried for 3 consecutive years since 1987 on 3 important crops, transplanted and wet-seeded rice, peanut and blackgram. Works on peanut showed that yield reduction due to weeds ranged from 51% to 78% compared to weed-free peanut. The study also confirmed that the traditional weed control method was not adequate to check yield reduction of peanut (Tables 6 and 7). Early weeding increased the number of pods and branching per plant. Plant height and 100 seed weight were not affected by the different time of weeding. This study also showed that peanut must be kept weed free for 6 to 9 weeks after emergence.

No appreciable yield loss is observed in traditionally weeded transplanted rice but there was 30% yield reduction if weeding is not done. Yield reduction of weedy and traditionally weeded plots of wet-seeded rice were almost the same. Yield loss in blackgram seems to be higher compared with that of lowland rice but the current farmers' practices of weed control in blackgram seems to be effective (Table. 8).

2. Evaluation of Weed Control Methods and Practices

Weed control methods currently practiced by farmers for 12 different crops were surveyed through 32 extension workers undergoing training on legume production at CARI. Results indicated that Myanmar farmers normally weeded their crops at least once or twice except pigeon pea, because of longer duration, and chillies, due to wider spacing, required at least 3 weedings. The first weeding was done from 7 to 20 days after seedling emergence followed by the second weeding 20 to 30 days later (Table 9). The most commonly practiced method is hand weeding with hoe in most crops but some used other hand tools. Some advanced farmers utilized several types of animal-drawn implements, like wooden harrows, planet junior cultivator and plow. Weeding costs has been variable and depends on the kind of crops and locality.

To correct yield reduction due to weeds in upland rice in Aungabn and Kyaukme a weed control study was done for 2 years in Aungban. Results indicated that yield losses can be as high as 40% in unweeded plots but negligible in plots using conventional methods. Rice yield of plots treated with Satunil 60 E generally outyielded the weed-free plots (Table 10). By economic analysis, it appeared that using herbicide is more profitable than hand weeding because of higher labour cost in hand weeding.

Methods of weed control studies on blackgram and peanuts were also conducted in 1990 and 1991. There was failure in 1990 while results of this year are still in process.

FUTURE DIRECTION AND PLANS

The surveys so far conducted showed that both lowland and upland rice have weed problems and the one on the upland ecosystem has been more alarming. The studies at CARI also revealed that weeds caused considerable yield losses in

Table 9. Farmer's Weed Control Method in Myanmar, 1991

Crops	No. of weeding per	Growth stage of crop at	Implement used	Man hour/ (.62 ha)	Weeding cost per.62 ha (K)	Crop yield Kg. ha^{-1}
1. Lowland Rice	1 - 3	I: 15-30 DAE	HW, rotary weeder	20-50	60-450	2320-4130
		II: 45-70 "	"			
		III: 90 "	"			
2. Upland Rice	2	I: 15	HW, Hoe	50-100	150-900	1290-2320
		II: 45				
3. Peanut	1 - 2	I: 7-35	HW, Hoe, 5 tined	25-75	75-675	560-1260
	(occasionally-3)	II: 20-45	and 3 tined	(5)	(40-100)	-
		III: 45	harrow			
4. Sesame	1 - 2	I: 14-20	Sickle, Hoe, HW	5-10	15-90	180-420
		II: 40-45	Harrow	(5)	(25-45)	
5. Greengram blackgram & Cowpea	1 - 2	I: 7-10	HW, Hoe	15-40	45-360	400-470
		II: 20-35				
6. Pigeon pea	1 - 3	I: 25-30	HW, Hoe, Harrow	50	150-250	3230
		II: 45		(5)	(25-45)	
		III: 65				
7. Corn	1 - 2	I: 20-30	HW, plow	40-50	120-150	1850-3090
		II: 45		(5)	(40-100)	
8. Cotton	2	I: 14-21	HW, Hoe	35-40	105-200	280
		II: 45				
9. Butter bean	1 - 2	I: 20-25	HW, Harrow	20	60-100	2020-2420
		II: 35		(5)	(35 45)	
10. Chillies	3	I: 10	Hoe, Planet	40-80	120-400	300
		II: 30	junior	(5)	(35-50)	1210-1820
		III: 45-60				
11. Jute	2	I: 30	Sickle, Hoe	75	225-375	1620
		II: 45				
12. Sunflower	1 - 2	I: 15-30	Hoe,Harrow	25-40	75-200	430-720
		II: 60				

Remarks: (1) HW = Hand Weeding; (2) figure in parenthesis in man-hour column is time required for a pair of bullock; (3) daily working hours of a farm worker is 6 hrs; (4) daily wages range from K15-45/day but K25 is more common; (5) wages for a pair of animal is K30-100; I = first weeding; II = second weeding; III = third weeding.

Table 10. The effect of Satunil 60 EC (propanil + Benthiocarb) on upland rice yield at Aungban, 1989-1990.

Treatments	1989		1990	
	weed count per (.62 m^2)	yield ton/ha	weed count per (.62 m^2)	yield ton/ha
Satunil 60 EC, 6.25 L/ha	120 abc	2.3	14 a	4.5 a
" 7.5 "	214 ab	2.4	7 b	5.1
" 8.75 "	175 a	2.3	7 b	5.5 a
" 10 "	165 a	2.3	9 b	5.5 a
Hand Weeding	379 bcd	2.2	23 a	4.5 a
Weedy Control	451 d	1.8	23 a	2.7 b
Traditional Method	402 cd	2.2	-	-

Means with the same letter are not significantly different by DMRT.

the crops studied. Thus, a more active and intensified programme in weed science is needed to be implemented immediately in collaboration with other disciplines. The following are planned to be included in future programme:

* Yield loss assessment on rice, corn and sesame.
* Weed control methods for economically important crops; will emphasize more on chemical and mechanical methods, using improved weeders.
* Weed collection and identification, including training of plant taxonomist abroad to speed up the process.
* To study weed ecology in Myanmar and publish results as book.

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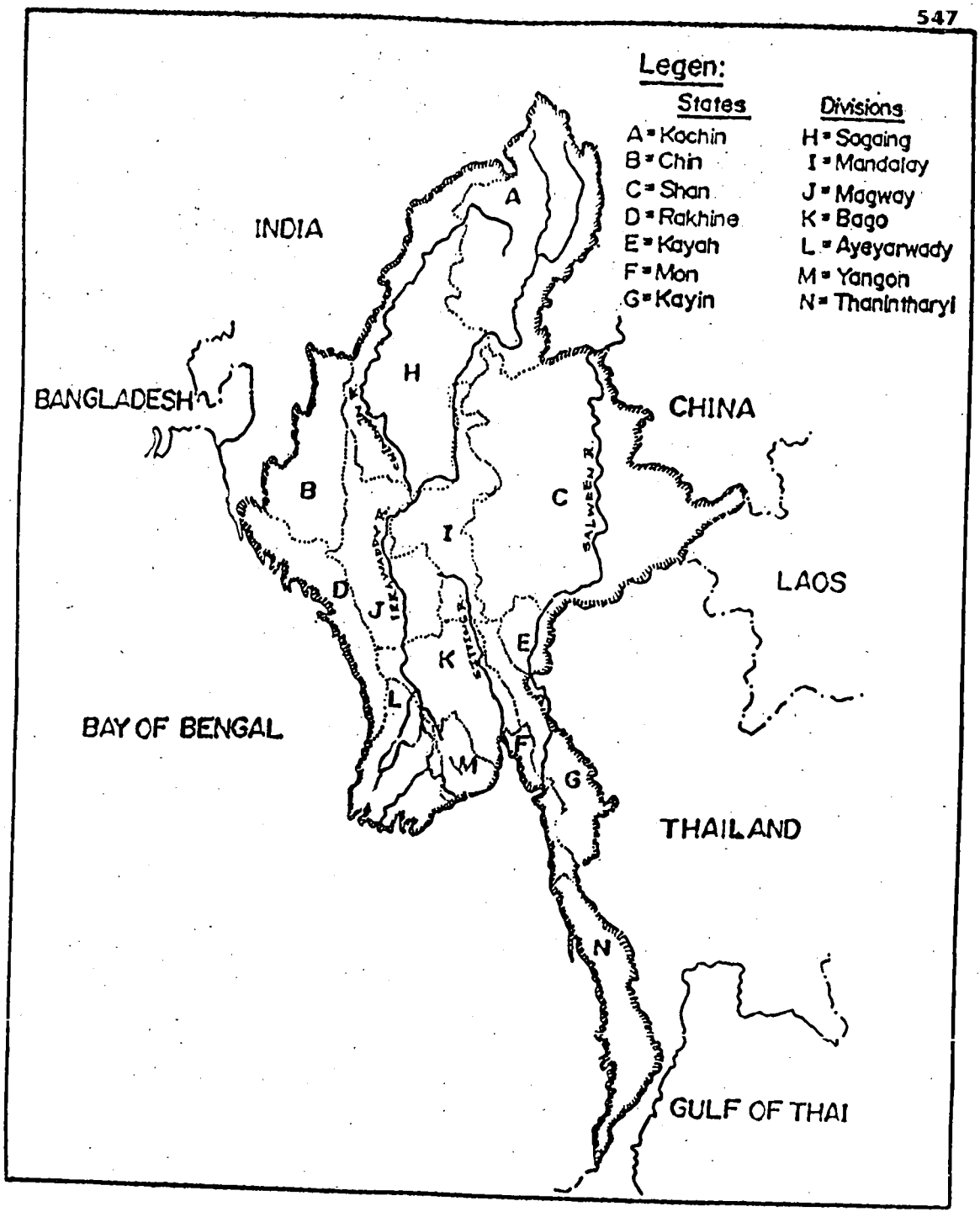

Fig 1. Maps of Myanmar showing different States and Divisions

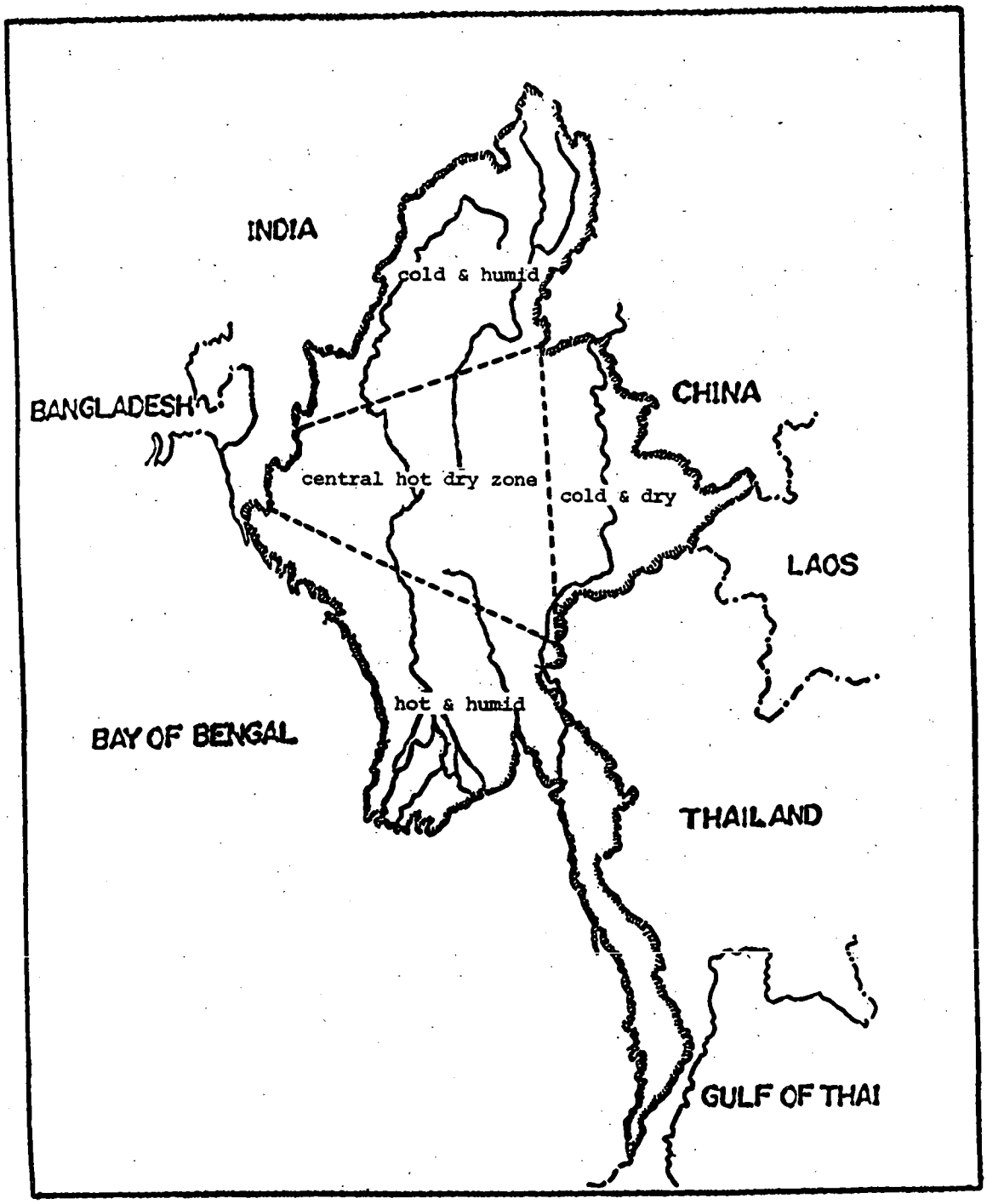

Fig 2. Maps of Myanmar showing location of different ecological zones.

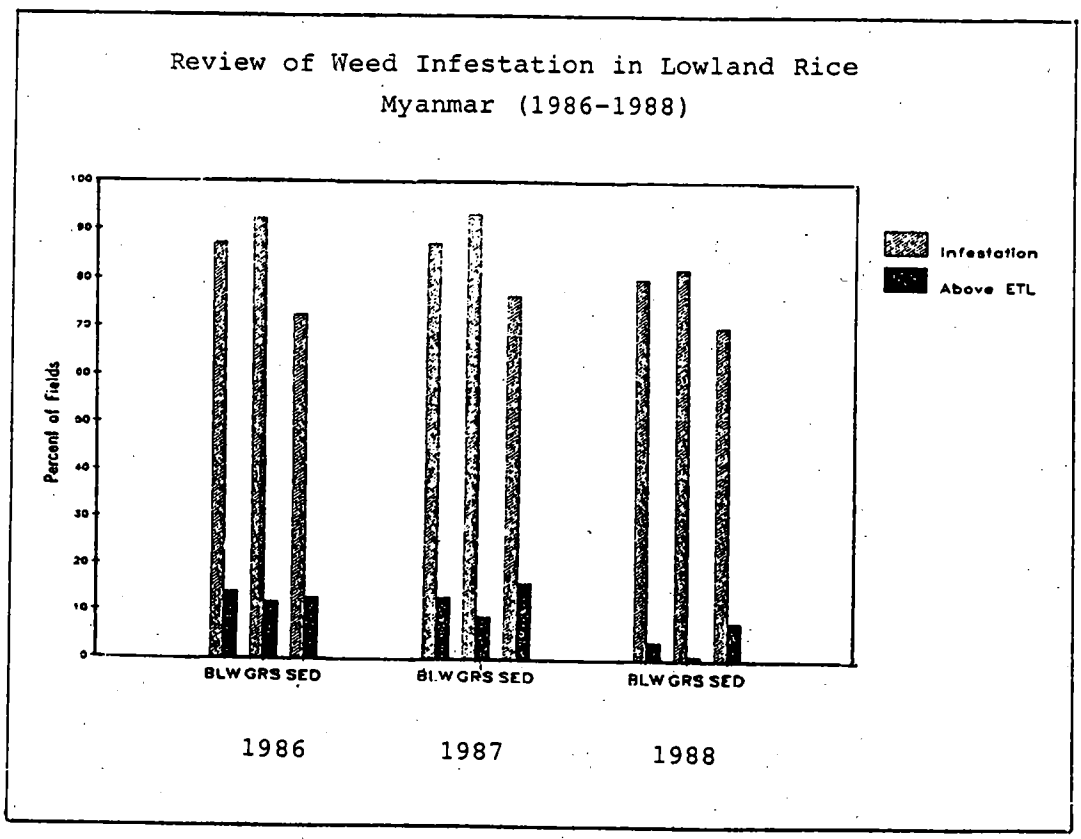

Fig 3. Review of Weed Infestation in Lowland Rice, Myanmar, 1986-1988 (from Plant Protection Group of MAS)

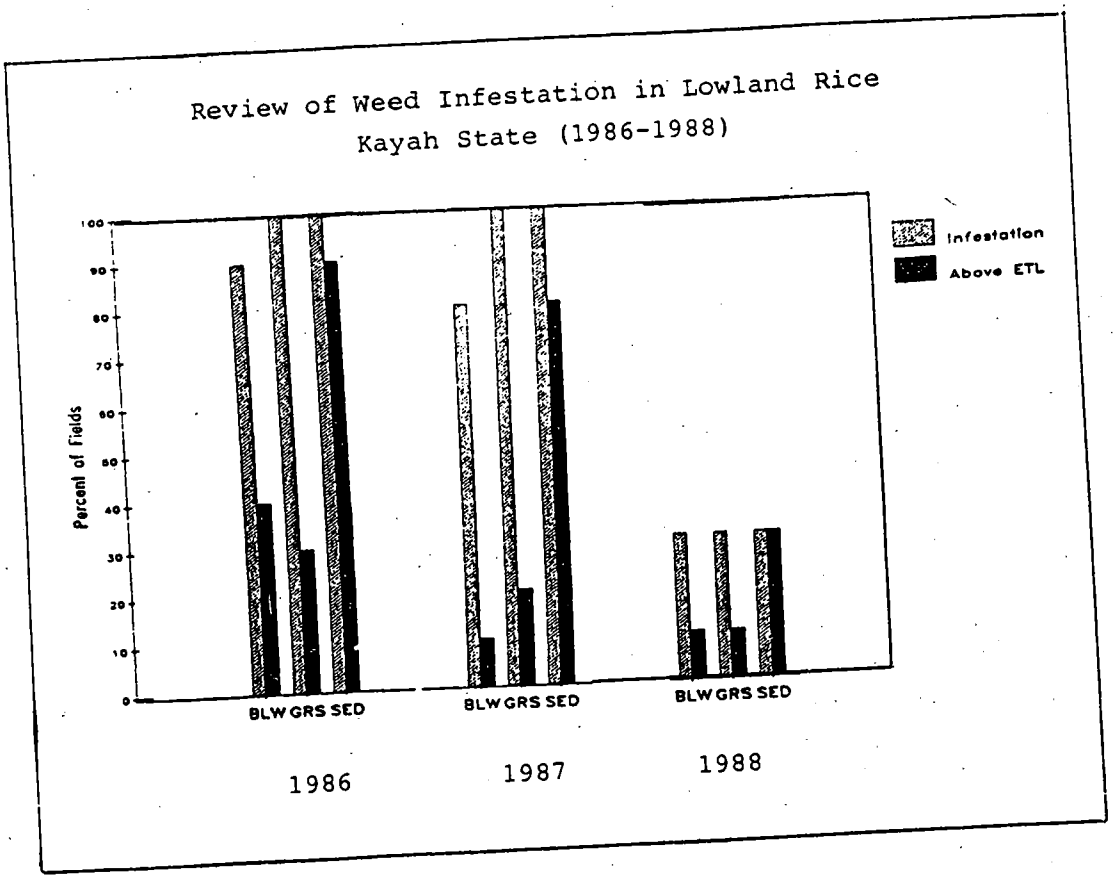

Fig 4. Review of Weed Infestation in Lowland Rice, Kayah State, 1986-1988 (from Plant Protection Group of MAS)

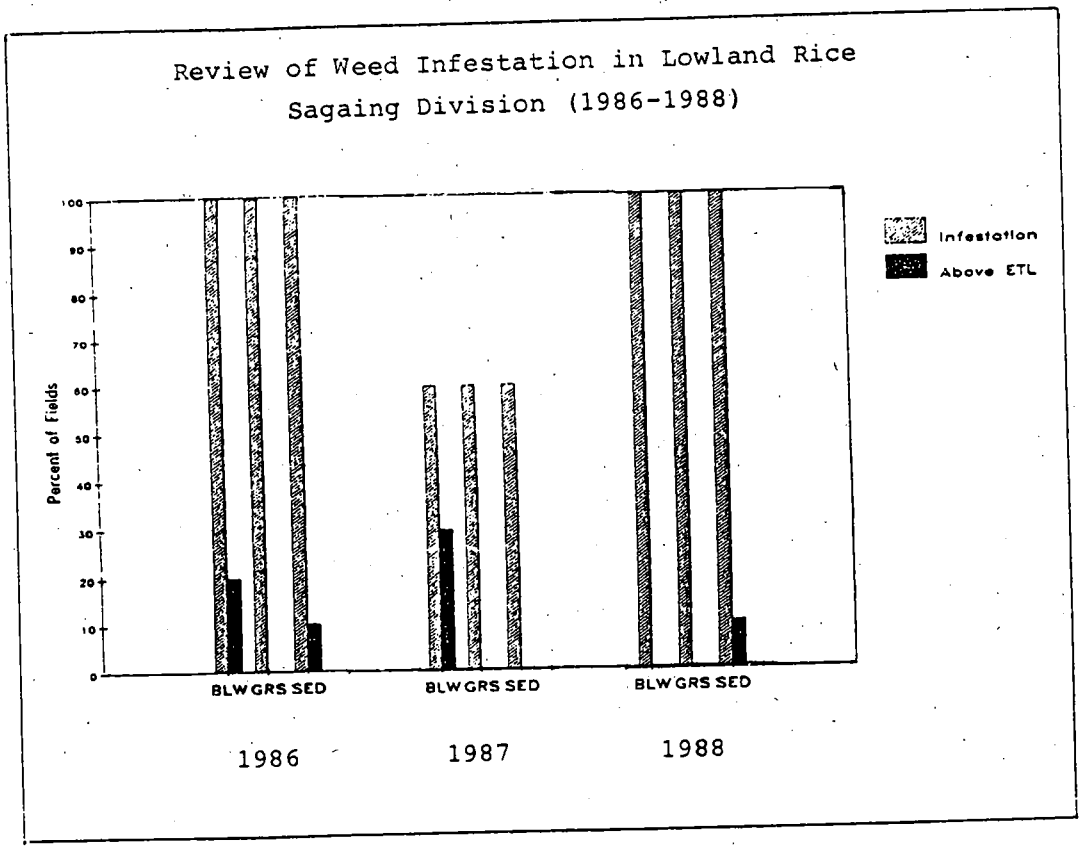

Fig 5. Review of Weed Infestation in Lowland Rice, Sagaing Division, 1986-1988 (from Plant Protection Group of MAS)

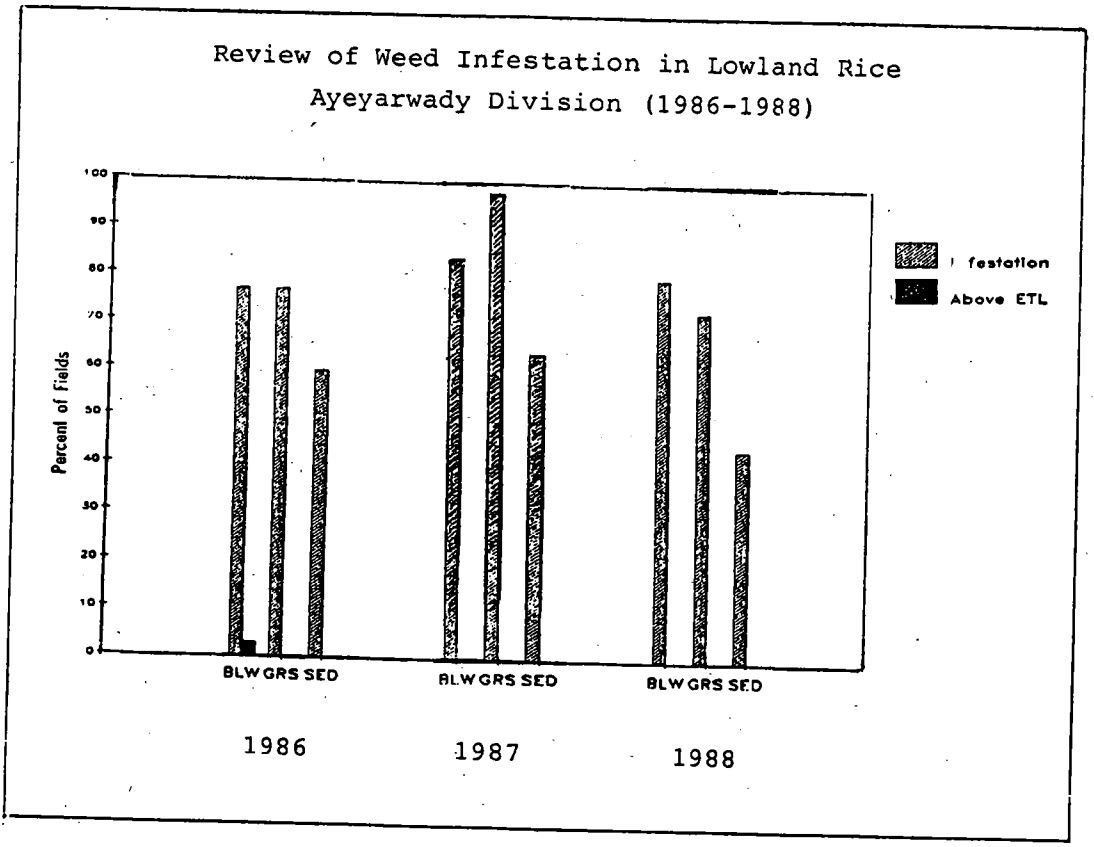

Fig 6. Review of Weed Infestation in Lowland Rice, Ayeyarwady Division, 1986-1988 (from Plant Protection Group of MAS)

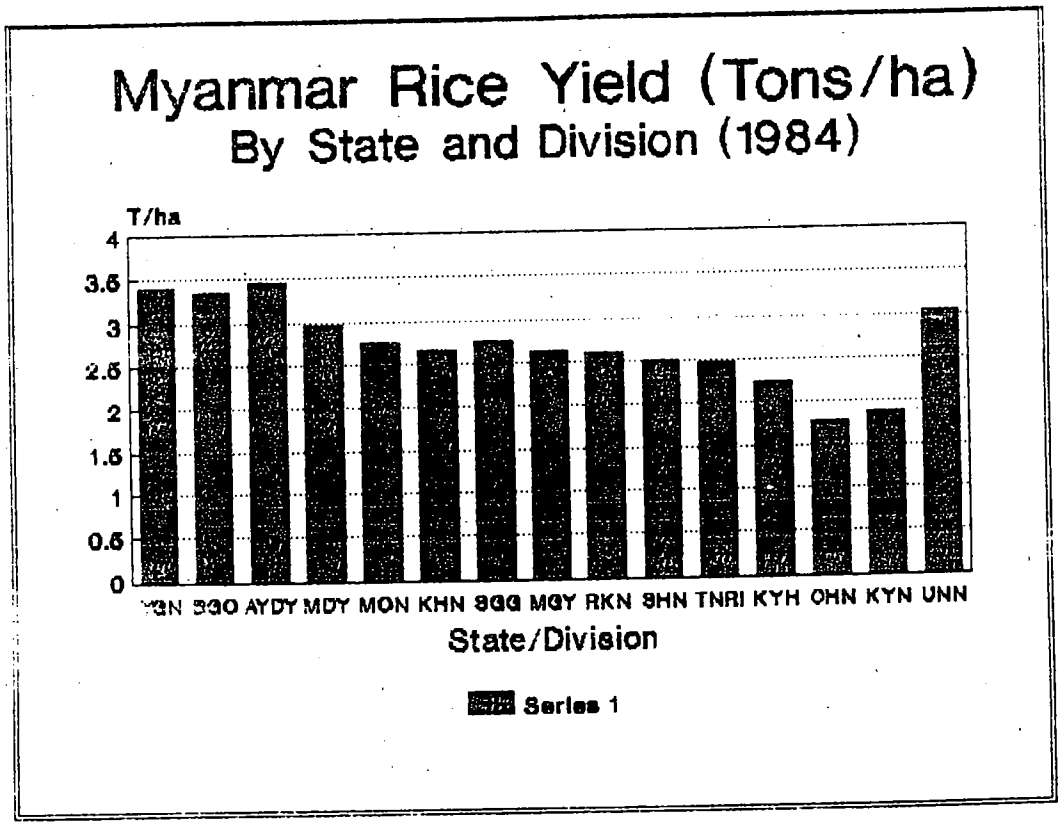

Fig 7. Rice yield in Myanmar by State and Division, 1984