Effect of planting dates on late blight severity and tuber yields of different potato varieties

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Abstract

An experiment was conducted at Holetta Agricultural Research Centre (HARC) in 1993, 1994 and 1996 main growing seasons, to investigate the effect of varieties and planting dates on late blight severity and potato tuber yield with and without fungicide application. The length of time between crop emergence and the first late blight symptom was positively correlated ($R^2 = 0.41$) with tuber yield. Disease severity expressed as area under the disease progress curve (AUDPC) was significantly ($p < 0.05$) higher in early planting than in the late planting. Yield differences between planting dates and interaction between variety and planting dates were significant ($p < 0.05$), but yield decreased as planting dates were delayed. The effect of planting date was more important to reduce late blight, to help escape the crop from early stage disease attack and increase tuber yield in both susceptible and moderately susceptible varieties. Moreover, fungicide applications significantly ($p < 0.05$) reduced the AUDPC and increased tuber yield. This study showed integrating host resistance, early planting and reduced frequency of fungicide application best-controlled late blight and increased tuber yield.

Introduction

Late blight of potato caused by *Phytophthora infestans* (Mont) de Bary is the single most destructive disease of potato in the world (International Potato Centre (CIP) 1989). The average global crop losses of all diseases combined was approximately 12.8 % of the potential production but potato alone was subjected to 21.8 % loss (James 1981). In Ethiopia the disease reportedly caused approximately 100% crop loss on unimproved local cultivar, but on a susceptible variety, Al-624 yield reduction was 67.1% (Bekele and Yaynu 1996).

At a global level, the major approach to prevent late blight development has been application of fungicides (CIP 1989). Likewise, in Ethiopia, farmers used to apply fungicides to protect the disease and studies on the economic feasibility of fungicide use to control the disease proved to be profitable (Holetta research Center Progress Report 1996 and 1997). However; the experience else where showed that, lack of experience in the use of fungicides led farmers to serious problems in their health (Schustere and Schroeder 1990) and environmental pollution. However, reduced use of fungicide application became attractive in late blight control (Fry 1977) and in the control of other diseases such as rice blast (Chin 1985). Hence, these advantages have stimulated further efforts to devise control methods, which will increase the efficiency of fungicides and reduce the total amount needed per season.

Use of resistant varieties is another main component to control late blight and is more effective under tropical condition (Shtienberg et al. 1994). However, the existing released potato varieties with race-specific oligogenic resistance (CIP 1989), can be rapidly broken down by a compatible race of *P. infestans* rendering the varieties to be susceptible to the disease within a short period (Shtienberg et al. 1994).

Another important component in the control of late blight that has received little attention in Ethiopia is shifting planting date of potato. For late blight, in which infection is not tied with crop growth stage planting time seems important control component (Warren et al 1971). Besides, Zadoks and Shein (1979) indicated the relevance of planting time to inciting or escaping damage by the disease. Other reports (Teasfahun 1989; Tesfaye and Anteneh 1999) also substantiated the previous findings. Therefore, the objectives of this study were to test the effect of varieties with different levels of resistance to late blight and varying planting dates, on late blight severity and tuber yield with and without supplementary fungicide applications.

Materials and Methods

The experiment was conducted in 1993, 1994 and 1996 at the HARC, which was laid out in paired treatment in split plot design (LeClerg 1974). Varieties were assigned to main plots and planting dates to sub plot. Three varieties that have different degree of responses to late blight, Tolcha (tolerant), Awash (moderately susceptible) and AL-624 (susceptible) were used. The sub plot treatments were four planting dates: June 7, June 21, July 5 and July 19 in 1993 and 1994 but in 1996 planting was made on June 3, June 18, July 3 and July 18, two weeks before and up to a month after mid June, the recommended planting date for potato in the area (Gebremedhin and Berga 1989). However, early June planting depended on the amount of rainfall received. The plot size for main plot was 3m x 9m, while for sub plot it was 3m x 3m, in three replications. Spacing between rows and plants were 0.75m and 0.30m, respectively. At planting, 138 kg P_2O_5 and 54 kg N ha $^{-1}$ as Di-ammonium phosphate (DAP) were side-dressed. Ridomil MZ (Metalaxyl + Mancozeb) 63.5 % WP, a fungicide which has a systemic and protective action was applied at a rate of 2.5 kg ha $^{-1}$ immediately after the onset of the first disease symptom and subsequent spray was made as the need arose. Thus, AL-624 was sprayed three times and Tolcha only once in a season, whereas the moderately susceptible variety, Awash was sprayed once per season in 1993 and 1994 and twice in 1996. In order to minimise the fungicide drift and other interference's between treatments each block was separated from its adjacent blocks with three dense rows of oat.

Late blight was recorded based on percent leaf area infected at seven days interval starting from the onset of the first symptom (Jan 1987). Disease-free period in days from crop emergence to onset of the disease was also recorded. Disease data of seven readings in 1993, nine readings each in 1994 and 1996 were integrated into AUDPC (Campbell and Madden 1991) using the following formula:

$$AUDPC=\Sigma_{i}^{n} = (x_i + x_{i+1}) (t_{i+1} - t_i)/2, \text{ where}$$

n is the number of observations, t_i days after planting for the i^{th} disease assessment and Y_i disease severity. In order to see the critical time for disease progress and its relation to weather factors, apparent infection rate (r) was calculated using the formula developed by Zadoks and Schein (1979): $r = (1/t_2 - t_1) [\log_e (x_2/1 - x_2) - \log_e (x_1/1 - x_1)]$, where t_1 and t_2 were dates of observation, x_1 and x_2 are proportion of tissue damaged on the dates. Combined analysis was not performed due to heterogeneous error terms between years. Analysis of variance (ANOVA) was done with statistical package MSTAT-C. Percent disease severity was transformed using arc-sine transformation and subjected to ANOVA as suggested by Gomez and Gomez (1984).

Results

Varietal effect

Late blight severity expressed, as AUDPC was relatively high in 1996 when compared with those of 1993 and 1994 by 21 and 19 % respectively (Tables 1,2 & 3 and Fig. 3). Disease symptom also appeared on the susceptible variety earlier in 1996 than in 1993 and 1994. Disease onset on the varieties was found significantly ($P<0.05$) different. On AL-624 it was recorded 5 days earlier than on Awash and 14 days than on Tolcha in 1993 (Table 1), whereas in 1994 it was earlier by 11 days and 19 days compared to the latter two varieties, respectively (Table 2). The same trend was observed in 1996 and on AL-624 the symptom was observed 7 days earlier than Awash and 17 days than Tolcha (Table 3). In all years the variety least affected was Tolcha, followed by Awash and AL-624. In 1993 the AUDPC on AL-624 was higher than Tolcha by 54% and than Awash by 42 %, whereas the difference between the latter two was only 12 %. However, in 1994 the differences were non-significant, only 16 % between AL-624 and Tolcha and as low as 6 % between the former and Awash. In 1996 the level of severity on the susceptible variety was higher by 30% than the tolerant variety and by 6% than the moderately susceptible variety.

As shown in tables 4, 5 & 6 significantly higher AUDPCs were recorded in unsprayed than sprayed plots. Fungicide application significantly ($p<0.001$) reduced the AUDPC which was negatively and significantly correlated with tuber yield ($R^2 = 0.319$) in 1993, $R^2 = 0.706$ in 1994 and $R^2 = 0.383$ in 1996) (Table 5). The highest AUDPC was recorded on the unsprayed early June planting dates but under sprayed condition the severity was significantly reduced ($p<0.001$). Though the AUDPC in mid July planting was lower, fungicide application still highly and significantly ($p<0.05$) reduced the severity of the disease in all experimental years.

Potato tuber yields differed significantly ($P<0.05$) among the three varieties in all experimental years (Tables 1,2,3 and Fig. 3). Tolcha, the resistant variety gave consistently and significantly highest tuber yields: 23.4 t/ha, 11.7 t/ha and 21.6 t/ha in 1993, 1994 and 1996, respectively. But the moderately susceptible variety, Awash yielded 16.6 t/ha in 1993, 7.1 t/ha in 1994 and 11.3 t/ha in 1996, whereas AL-624 gave the lowest yields: 8.7 t/ha, 4.6 t/ha and 5.6 t/ha in 1993, 1994 and 1996, respectively.

Planting date effect

The disease symptom appeared on the three varieties in a range of 27 to 45 days after crop emergence from the first to the last planting in 1993. Whereas in 1994 and 1996, the range was between 21 to 38 and 19 to 40 days, respectively, the shortest period being in mid July planting (Table 1, 2 and 3). Among the planting dates, late planting resulted in consistently and significantly lower ($p<0.05$) AUDPC as compared to early planting (Tables 1, 2, 3 and Fig. 3). The highest AUDPC was recorded on the susceptible variety AL-624 in early June planting, while in the subsequent plantings the severity of the disease was reduced and was significantly lower. However, planting date was significantly and negatively correlated with disease severity (R^2 = -0.162) only in 1996 but the relation was not significant in 1993 (R^2 = 0.034) and in 1994 (R^2 = 0.065 (Table 3). Though the AUDPC of AL-624 was higher in early and mid June plantings, the progress of the disease was slow as opposed to those planted in early and mid July (Fig. 1). On the other hand the apparent infection rate in the critical epidemic period was similar and was found non-significant among planting dates (Figure 2).

Potato tuber yields differ significantly ($p<0.05$) among planting dates (Table 1, 2, 3, and Fig. 3). As the planting date delays, there was a gradual decline in yield of potato, the lowest being on mid July. Early June planting gave 25.7 t/ha in 1993, 13.4 t/ha in 1994 and 20.1 t/ha in 1996. When planting was delayed by 15 days (mid June) tuber yield was significantly reduced, 6.1 t/ha in 1994 and 16.2 t/ha in 1996. Generally, significant ($p<0.05$) yield reduction was not in-countered when planting was delayed from early July to mid July. The relation between planting date and tuber yield were significant ($p<0.05$) and negatively correlated (Table 7). Yield differences between sprayed and unsprayed plots of the same variety even under very late planting (mid July) was significantly ($p<0.05$) higher (Table 4, 5 & 6) and was positively correlated with tuber yield (Table 7). However, mid July planting of AL-624 and mid July (1993), mid June (1994 and 1996) and early July (1996) plantings of variety Tolcha did not show significant differences between sprayed and unsprayed plots.

Discussion

In all the seasons the effect of variety and planting dates as components of control measure against late blight were observed to be good source of the variation in disease severity and yield obtained. Generally the variety Tolcha, was least affected by late blight (Tables 1, 2, 3 and Fig. 3), while AL-624 was the most affected variety followed by Awash. However, Awash showed increased susceptibility particularly in 1996 probably because the variety gradually may have lost its race specific resistance. Progress of the disease was slow in early plantings, whereas in late plantings the progress was faster as shown in the last two sections of Fig. 1. This may be because in June plantings there was no consistent high humidity conducive for disease development, that is, symptom development ceases when the weather is dry and resumes when the humidity rises above 75% (Colhoum 1979). Whereas in July and August often there was higher humidity for longer period of the day conducive for profuse sporulation of the pathogen, that makes it life cycle shorter. Again the growth and sporulation of the pathogen and disease development ceases as soon as dry, hot weather sets in towards the end of the season. Therefore the severity of the disease was reduced in late-planted plots and consequently the AUDPC was lower.

Disease free period for each planting date was different and symptoms were observed at emergence (mid-July planting), stem development (early July planting) and flowering (early and mid June planting) (Tables 1, 2 & 3). This implies that specific growth stage of the host was not associated with any specific feature of the epidemic. Warren et al. (1971), reported that at different growth stages of the potato crop, a part of the plant (top, intermediate or bottom leaves) is susceptible to infection by *P. infestans*. That means at any stage of the crop symptom could develop provided that inoculum is available and weather is conducive for infection and development of the pathogen.

Length of the blight free period was also significantly higher in June plantings than July plantings in all three seasons and was positively related (R^2 = 0.587) to tuber yield. However, the differences between June and July plantings were not significant ($p<0.05$). Early planted plots in which symptom appearance was late by 15 days (in 1993), 17 days (in 1994) and 21 days (in 1996) as compared to late-planted plots gave significantly higher yield. This indicated that late blight free period has a positive influence on tuber yield. Olofsson (1968) also reported a significant relationship between yield and length of the blight free period, i.e. from planting to the date when blight is first noted. Hence, plots with longer late blight free period were gave more yields than plots with shorter late blight free period.

Development of late blight epidemics depends greatly on the effect of humidity and temperature (Agrios 1978). The fungus sporulates most abundantly at a relative humidity of about 100 percent and at temperatures between 16 and 22 ^{0}C. For different stages of life cycle such as germination of sporangia, for penetration of germ tube and mycelia development the temperature requirement range is between 10 to 25 which often prevails at Holetta. Though AUDPC was lower in late planted (Early July and Mid July) plots than early planted (Early June and Mid June) ones, plotting apparent infection rate (r) against planting time indicated that infection rate was not significantly variable at the middle of the season. That was influenced probably by higher relative humidity (Fig.2) with continuous rainfall under lower air temperature (Table 6). This result implies that the epidemic of the disease on late and early-planted crops on the same variety is similar. However, it was more pronounced on the young late-planted crop than on relatively with more foliage early planted ones. This condition again suggests that, in potato, the amount of inoculum build-up and conducive weather conditions (Lapwood 1968) rather than plant development stage determines epidemic. Therefore, potato planted early can escape critical physiological period such as tuber initiation from the disease attack than late-planted potatoes where the disease epidemic period coincides with tuber initiation period of the crop.

Tuber yield was positively and significantly ($p<0.05$) correlated ($R^2 = 0.122$) with variety in 1996 but it was not significant for 1993 and 1994 (Table 5). The reason for non-significant correlation in the first two years was probably due to low disease pressure. In all cases in early planted (early June and mid June) potatoes there was higher level of disease severity but gave higher tuber yield than late planted potatoes (early and mid July). This is because in the latter the disease started at early growth stage of the crop followed by fast disease progress before the crop reached senescence. Whereas in plots planted earlier first disease symptom was observed when the crop stage was at flower initiation period and the development of the disease was slow and reached maximum when the crop reached close to senescence. Hence, the disease effect on yield was relatively lower on early-planted potato than on late planted ones. After the first disease foci prevailed, the time for disease development in early-planted potatoes was longer than that of late planting which in return is associated with the weather. This complies with the previous finding (Tesfahun 1989).

Among planting dates, yields of varieties were variable (Tables 1, 2, 3 and Fig. 3). Late planting resulted in consistently lower yields and lower AUDPC for all varieties as compared to early planting. The correlation of planting dates with yield was significant, where R^2 = 0.254 in 1993; R^2 = 0.436 in 1994 and R^2 = 0.214 in 1996. This yield result was substantiated by the findings of Tesfaye and Anteneh (1999). However in respect to the disease severity the authors associated early planting with low AUDPC and late planting with high AUDPC which did not happen in this study. Differences in the result probably encountered because of environmental variation between the sites where the trials were conducted. However, although delayed planting may limit damage caused by late blight, it predisposes the crop to adverse environmental conditions such as early onset of moisture stress and lower yield potential as a result late planting may negate this benefit. Since the tuber yield advantage was more than the late-planted situations as stated by Tesfahun (1989), higher yield could be obtained with early planting. But, substantial yield reduction could also occur from the disease if control measures are not practised (Table 2).

Generally, the yield of potato had increased with early plantings and AUDPC also increased with this early plantings but the infection rate (r) was non-significant between planting dates when the weather was conducive to the disease development. However, the tolerance response level of variety Tolcha to the disease or control of the disease with fungicide application of moderately susceptible and susceptible varieties Awash and AL-624 respectively under reduced frequency of fungicide application allowed early planting to increase potato yield per unit area. Moreover, early planting enhanced fungicide efficiency and reduction of fungicide application as desired both for economical advantage as well as environmental protection. Thus, within the recommended month for planting it is worse to plant potato crop as early as possible after receiving sufficient moisture in the area.

Table 1. Effect of planting date on potato late blight severity and tuber yields of different varieties in 1993 at Holetta

Parameters	Variety				Planting Date [4]				
	AL-624	Awash	Tolcha	Mean	Early June	Mid June	Early July	Mid July	Mean
DO[1]	27bc[3]	32ab	41a	33	42ab	45a	27c	28c	35
AUDPC[2]	821.5a	291.9b	142.0b	418.5	652.8a	570.0a	298.2bc	251.0	443.0
Yield t/ha	8.7c	16.6b	23.4a	16.2	25.7a	23.0ab	9.2c	7.2c	16.2

Table 2. Effect of planting date on potato late blight severity and tuber yields of different varieties in 1994 at Holetta

Parameters	Variety				Planting Date[4]				
	AL-624	Awash	Tolcha	Mean	Early June	Mid June	Early July	Mid July	Mean
DO[1]	24b[3]	35ab	43a	34	38a	35ab	26abc	21bc	30
AUDPC[2]	750.8a	615.4a	462.8a	609.	867.4	637.5a	447.3	486.6	572.
Yield t/ha	4.6b	7.1b	11.7a	7.8	13.4a	6.1b	5.5b	6.3b	7.9

Table 3. Effect of planting date on potato late blight severity and tuber yields of different varieties in 1996 at Holetta

Parameters	Variety				Planting Date[4]				
	AL-624	Awash	Tolcha	Mean	Early June	Mid June	Early July	Mid July	Mean
DO[1]			39a	30					28
AUDPC[2]	1351.4	1181.5	466.6c	999.8	1567.0	1260		276.	900
Yield t/ha	5.6c	11.3b	21.6a	12.8	20.1a	16.2 b	8.4c	6.8c	12.9

[1]Disease onset after emergence in days. CV%: 23.4 for 1993; 41.1 for 1994 & 38.2 for 1996; [2]Disease severity as expressed by area under the disease progress curve. CV%: 16.5 for 1993; 15.3 for 1994 & 19.4 for 1996 Yield t/ha, CV%: 11.5 for 1993; 16.2for 1994 & 23.1 for 1996. [3]Values in the same row with common letter are not significantly different ($P<0.05$). [4]Early June - June 7 (1993 to 1994) and June 3 (1996); Mid June - June 21 (1993 to 1994) and June 18 (1996); Early July - July 7 (1993 to 1994) and July 3 (1996); Mid July- July 22 (1993 to 1994) and July 18(1996).

Late blight severity on potato varieties

Table 4. Effect of planting dates and fungicide on late bight severity and tuber yields of different potato varieties in 1993.

Parameters		Variety														
		AL-624					Awash					Tolcha				
		Planting Date														
Fungicide		Earl June	Mid Jun	Earl July	Mid July	X̄	Earl Jun	Mid June	Earl July	Mid July	X̄	Earl June	Mid June	Earl July	Mid July	X̄
No	AUDPC	1141	1193	526	425	812.3a	266	360	255	296	294.2b	250	160	114	43	141.7a
Yes		36		18	26			12	9	9		8	0	0	0	4.0b
No	Yield	14.3	16.	2.3	2.7		26.	22.5	8.7	8.9		36.6	30.4	16.5	10.0	23.4b
Yes		43.6	28.3	11.7	12.0	18.9a	34.0	31.3	17.0	10.5	23.2a	38.2	34.2	18.2	17.6	27.0a

CV % = AUDPC 31.8; Yield 16.7

Table 5. Effect of planting dates and fungicide on late bight severity and tuber yields of different potato varieties in 1994.

Parameters		Variety														
		AL-624					Awash					Tolcha				
		Planting Date														
		Earl June	Mid June	Earl July	Mid July	X̄	Earl June	Mid June	Earl July	Mid July	X̄	Earl June	Mid June	Earl July	Mid July	X̄
No	AUDPC	1061	843	482	616	750.5a	1006	559	390	506	615.2a	250	160	114	43	131.1a
Yes		121	64	56	46	71.7b	101	39	36	36	53.0b	41	38	43	42	41.0b
No	Yield t/ha	7.4	3.3	3.0	4.9	4.6b	11.3	7.3	4.3	5.7	7.1b	21.5	7.6	9.2	8.4	11.7b
Yes		22.1	14.3	6.5	10.7	13.4a	18.1	10.8	7.4	7.2	10.9a	18.3	13.8	10.5	9.8	13.1a

CV % = AUDPC 26.8; Yield 21.0

Table 6. Effect of planting dates and fungicide on late bight severity and tuber yields of different potato varieties in 1996.

Parameters		Variety														
		AL-624					Awash					Tolcha				
		Planting Date														
		Earl	Mid	Earl	Mid	_	Earl	Mid	Earl	Mid	_	Earl June	Mid June	Early	Mid July	_
No	AUDPC	198	161	123	566	1351.2a	197	154	105	151	1181.2a	738	615	402	101	464.0a
Yes		207	490	240	61	249.5b	277	230	245	61	203.2b	134	105	67	58	96.0b
No	Yield	8.7	7.5	2.2	4.2	5.6b	15.2	13.3	10.2	6.6	11.3b	36.6	27.7	12.8	9.5	21.6b
Yes		36.7	25.4	9.4	11.5	20.7a	33.3	28.7	19.3	13.3	23.6a	38.6	33.3	20.0	14.7	26.6a

CV % = AUDPC 44.3; Yield 18.7
1- Early June - June 7 (1993 to 1994) and June 3 (1996); 2-Mid June -June 21 (1993 to 1994) and June 18 (1996) 3-Early July - July 7 (1993 to 1994) and July 3 (1996); 4-Mid July- July 22 (1993 to 1994) and July 18 (1996). S- Significant and NS- None significant at P<0.05.

Table 7. Relations (R^2) of planting dates, varieties and fungicide application with late blight severity and tuber yield at Holetta in1993, 1994 and 1996.

Independent	AUDPC			Yield t/ha		
	1993	1994	1996	1993	1994	1996
Variety	0.158*	0.039	0.103*	0.083	0.46	0.122*
Planting dates	0.034	0.063	0.162*	0.254*	0.436**	0.214*
Fungicide	0.319**	0.711**	0.383*	0.198*	0.175*	0.297*

*Significant; ** Highly significant*

Table 8. Rainfall, Relative humidity, Maximum and Minimum temperature recorded in 1993, 1994, & 1996 main rainy seasons (End of May to October) at Holetta.

	1993				1994				1996			
Calendar	Rainfall	RH**	Temperature		Rainfall	RH**	Temperature		Rainfall	RH**	Temperature	
			Min.	Max.			Min.	Max.			Min.	Max
22	4.1	51.1	7.4	24.3	4.4	65.7	7.6	22.3	18.9	62.7	9.1	22.5
23	0.0	37.1	7.3	26.1	1.7	67.0	8.4	22.8	8.9	55.7	6.1	22.8
24	15.7	64.0	6.3	24.3	40.8	77.8	8.4	22.4	43.9	65.7	6.1	22.4
25	39.0	71.0	8.3	22.1	26.2	78.3	8.9	21.3	49.0	78.4	9.2	19.6
26	16.4	70.9	7.5	22.0	14.7	52.6	6.8	22.8	38.5	76.3	9.7	20.8
27	49.5	74.9	9.0	21.0	16.6	77.9	8.3	21.3	49.1	74.7	7.7	20.4
28	38.4	80.0	8.7	19.5	31.0	80.6	9.2	20.5	15.5	72.1	7.0	21.2
29	21.8	78.6	9.2	19.7	28.2	77.7	9.3	20.4	63.0	78.0	8.3	19.9
30	81.0	80.6	9.3	18.2	79.3	817	8.4	20.0	51.6	80.4	8.5	19.1
31	52.8	83.1	10.6	19.4	115.6	82.7	8.7	18.5	66.2	78.9	8.4	19.9
32	44.6	83.9	10.4	18.6	34.4	83.4	9.5	19.2	39.2	79.6	9.6	19.7
33	47 0	83.9	10.2	18.8	48.5	84.4	8.6	19.4	64.3	76.2	9.7	20.6
34	49.0	83.7	9.8	18.8	62.6	82.3	7.1	20.3	61.3	79.3	8.7	19.5
35	56.0	81.4	8.3	20.0	66.9	81.9	8.2	19.6	90.5	82.6	7.6	19.3
36	22.0	84.4	8.5	19.3	56.0	81.7	7.2	18.4	35.2	82.0	7.1	18.3
37	45.9	83.9	8.2	19.5	28.3	72.5	7.4	19.0	19.7	78.3	7.8	19.7
38	31.5	79.4	7.5	20.5	37.1	79.4	8.8	19.0	40.3	76.0	7.1	19.7
39	63.1	70.3	6.7	21.5	51.5	80.8	6.6	19.1	39.4	75.3	7.4	20.7

RH-Relative humidity
Calendar week: Week one started from January 1st

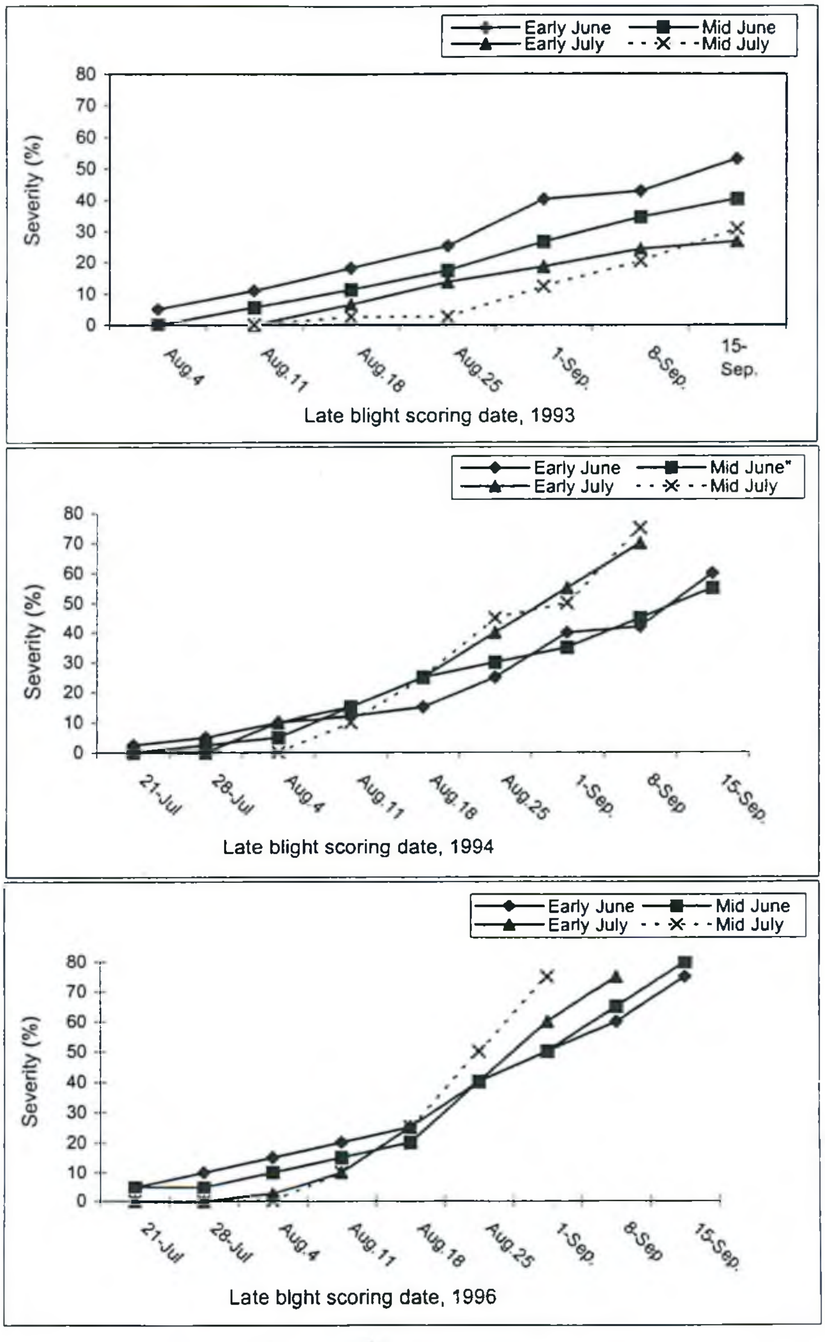

Figure. 1. **Progress of late blight on the susceptible variety AL-624 in relation to various planting dates at Holetta**

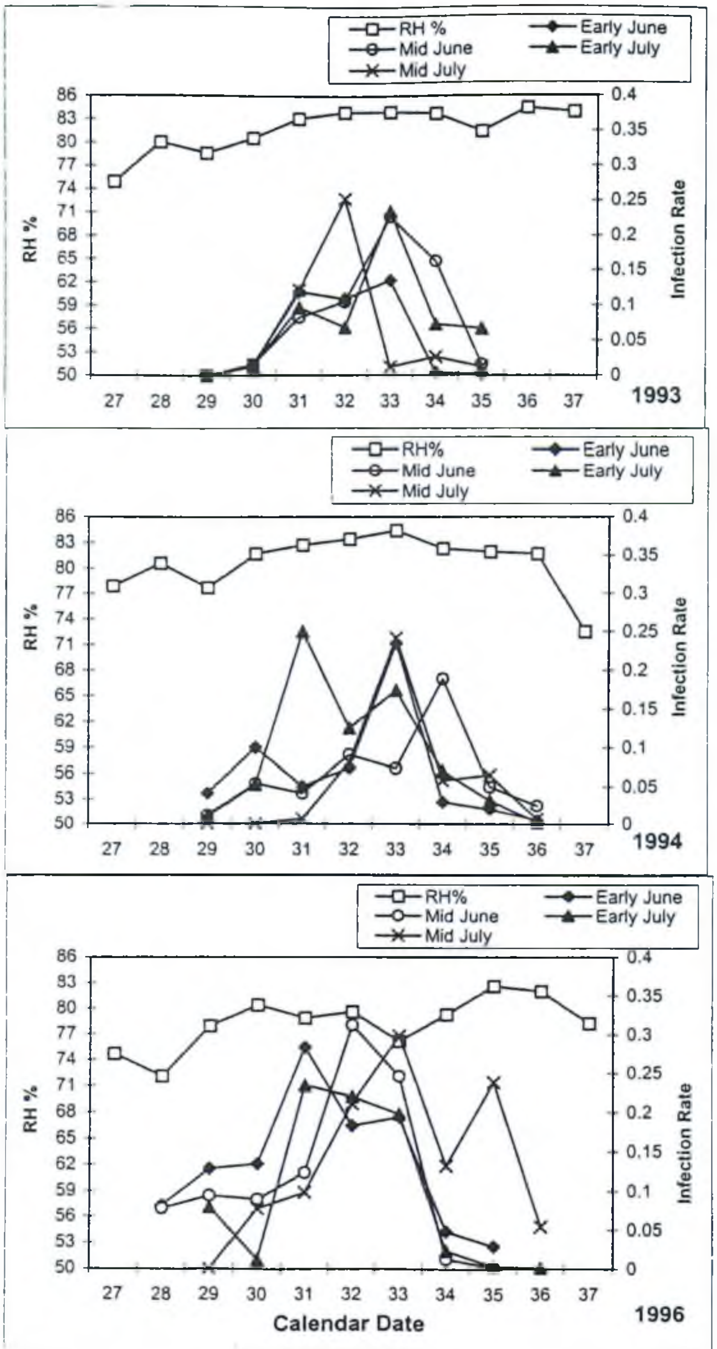

Figure 2. Influence of relative humidity on the infection rate of *Phytophthora infestance* in weeks conducive to the disease epidemics at Holetta.

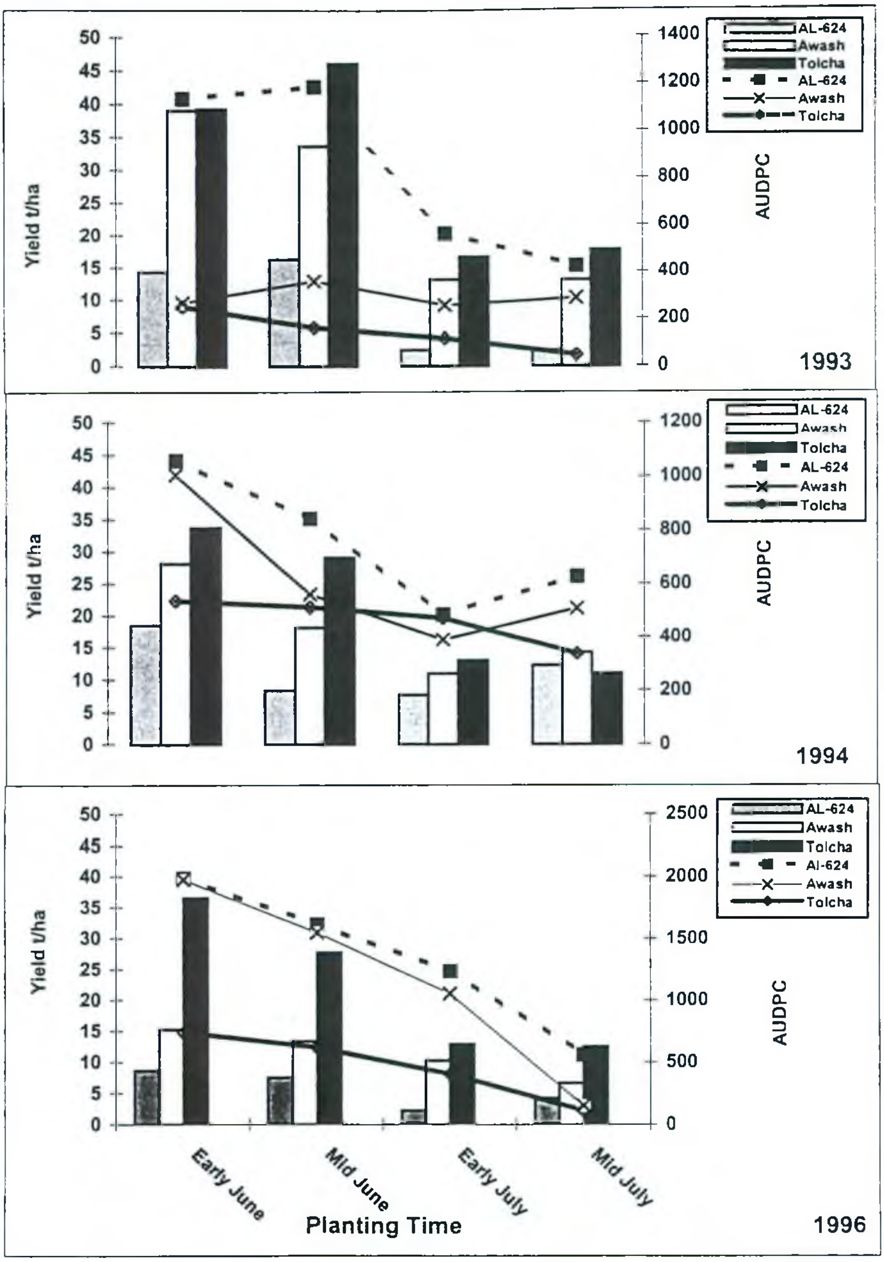

Figure 3. Interaction of planting time x variety on AUDP and tuber yield of potato at Holetta.

Acknowledgements

The authors thank Dr. Yaynu Hiskias for his initiation of this study and W/o Mintwab Haregeweyne, Ato Ejeta Tola and Ato Fantahun Feleke, all from EARO for their help in data collection, application of fungicide and other field work during experimentation.

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