BIBLIOGRAPHY

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ABSTRACT

The study was conducted to evaluate the resistance of snap bean cultivars to foliar and root diseases at Balili, La Trinidad, Benguet from September to December 2012.

The resistance of five pole snap bean cultivars were evaluated against bean rust disease caused by *Uromyces appendiculatus*, Fusarium root rot caused by *Fusarium oxysporum*, bean anthracnose caused by *Colletorichum lindemuthianum* and bean common mosaic virus.

The cultivar Sadsadan had the lowest incidence and severity of bean rust and bean anthracnose. Cultivar Alno (Black Valentine) had the lowest incidence and severity of bean common mosaic virus. Cultivars Taichung and Maroon had the highest incidence and severity of rust, anthracnose and bean common mosaic virus. The cultivar Taichung had minimal infection of Fusarium root rot.

Cultivar Maroon had the highest marketable yield while cultivar Taichung had the lowest.

RESULTS AND DISCUSSION

Incidence of Bean Common Mosaic Virus

Cultivar Alno/ Black valentine significantly had the lowest virus incidence which did not differ with cultivars Burik and Sadsadan (Table 1). The cultivar Maroon had the highest incidence bean common mosaic virus.The bean cultivars, Alno/Black valentine had low (Figure 3) while Maroon and Taichung (Figure 2) had the highest virus infection .It had a high infection of bean common mosaic virus since it was favorable to Temperature (16.5°c- 19.95°c), Relative humidity (84.75%-89%) and Rainfall (0.1mm- 9.2mm).The temperature range is within the appropriate temperature range of bean common mosaic virus which is 20^{o}c-25^{o}c (Alconero 1974). In bean common mosaic virus (BCMV), infected leaves are frequently mottled yellow symptoms and infected plants can be stunted (Figure 4) especially when infection occurs early in the plant development.

Bevoric et al (1996) reported that bean plants are the host for a number of viruses like common mosaic virus which known to be transmitted by seeds. The incidence of the virus diseases was confirmed on a considerable number of seeds. Transmission ranges from 20% to 26%.

Table 1. Incidence of bean common mosaic virus in bean cultivars

TREATMENT	MEAN	REACTION
Taichung	19.35[a]	Moderate susceptible
Maroon	20.15[a]	Moderate resistant
Burik	14.45[ab]	Moderate resistant
Sadsadan	15.90[ab]	Moderate resistant
Alno/ Black valentine	13.18[b]	Moderate susceptible
CV	21.40%	

Means followed by a common letter are significantly different at 1% level by DMRT.

Severity of bean common mosaic virus in bean cultivars

Reaction of bean cultivars against bean common mosaic virus shows that different bean cultivars were infected with the virus.It was observe that all cultivar were mild resistant to bean common mosaic virus. Among the cultivars, severity and reaction of bean cultivars in Alno/ Black valentine showed the lowest infection rating start at 25 to 60 days after planting. In addition, infection of the virus in cultivar Alno/ Black valentine was relative slow.

Table 2. Severity of bean common mosaic virus at different evaluation period

	DAYS AFTER PLANTING						
Cultivar	25	32	39	46	53	60	AUDPC
Taichung	1.20[ab]	3.00[b]	6.12[b]	15.75[b]	22.40[b]	29.4[b]	651.35
Maroon	1.72[a]	4.20[a]	9.17[a]	16.42[a]	24.55[a]	31.6[a]	740.67
Burik	0.75[bc]	1.37[b]	4.60[c]	8.52[d]	12.85[d]	17.4[d]	295.02
Sadsadan	0.60[c]	2.87[b]	5.85[b]	10.72[c]	15.77[c]	21.6[c]	487.73
Alno	0.22[c]	1.37[c]	3.25[c]	6.15[e]	9.97[e]	14.0[e]	391.62

Means followed by a common letter are significantly different at 1% level by DMRT.

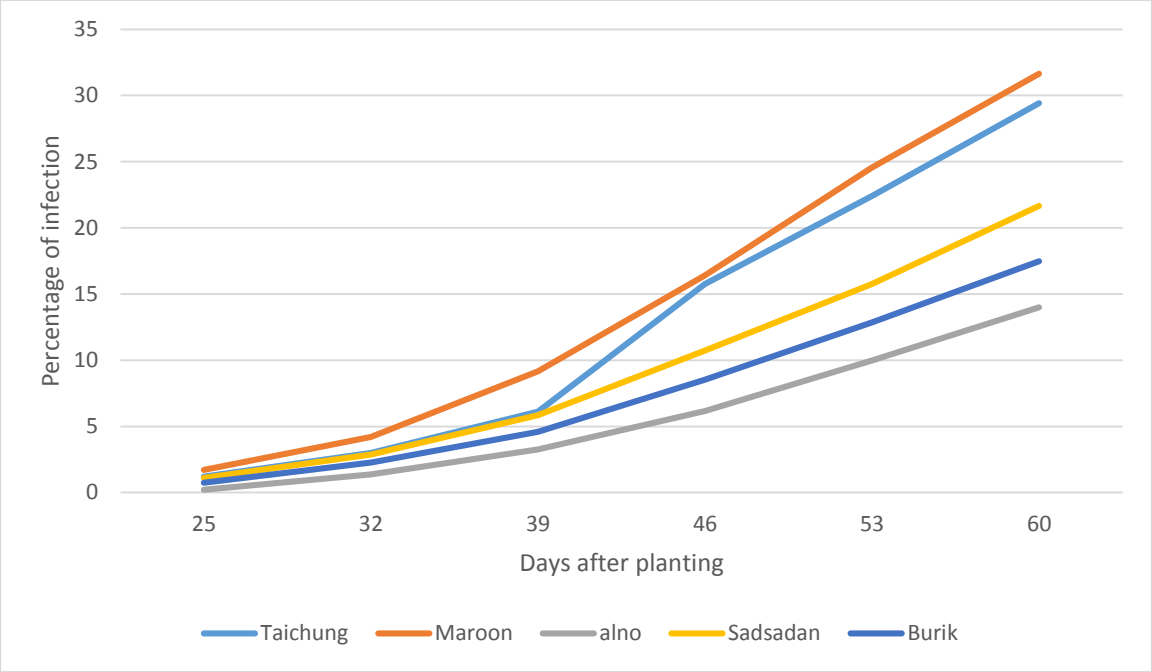

Figure 1. Severity of bean common mosaic virus.

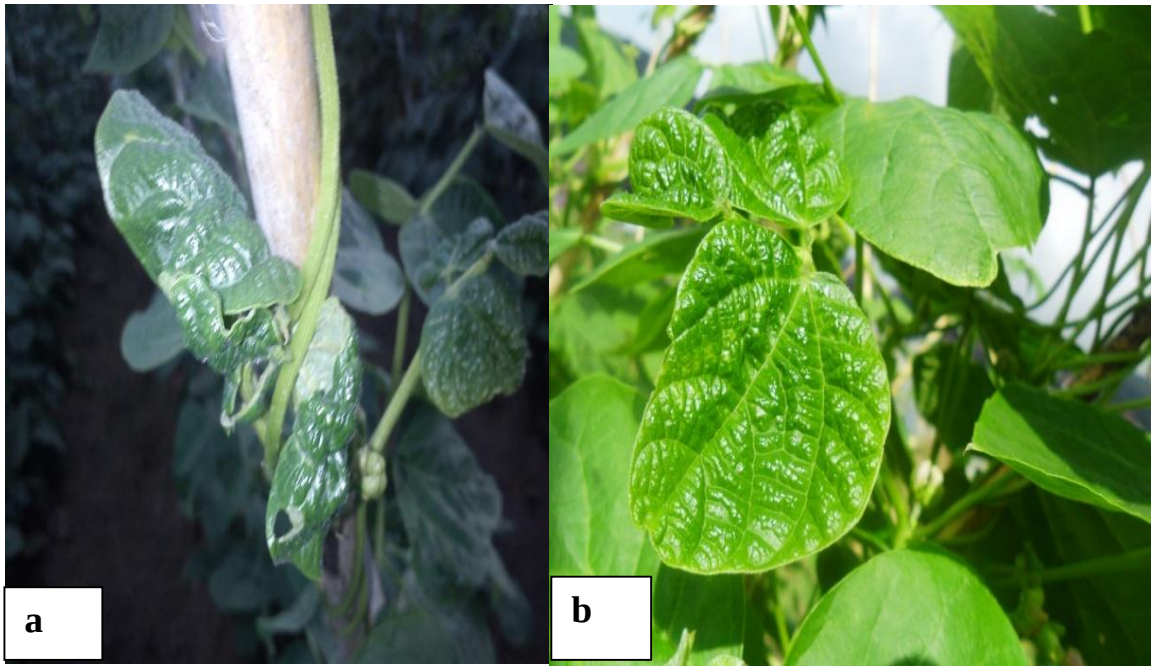

Figure 2.Infection of bean common mosaic virus in Maroon cultivar (a), Taichung cultivar (b)

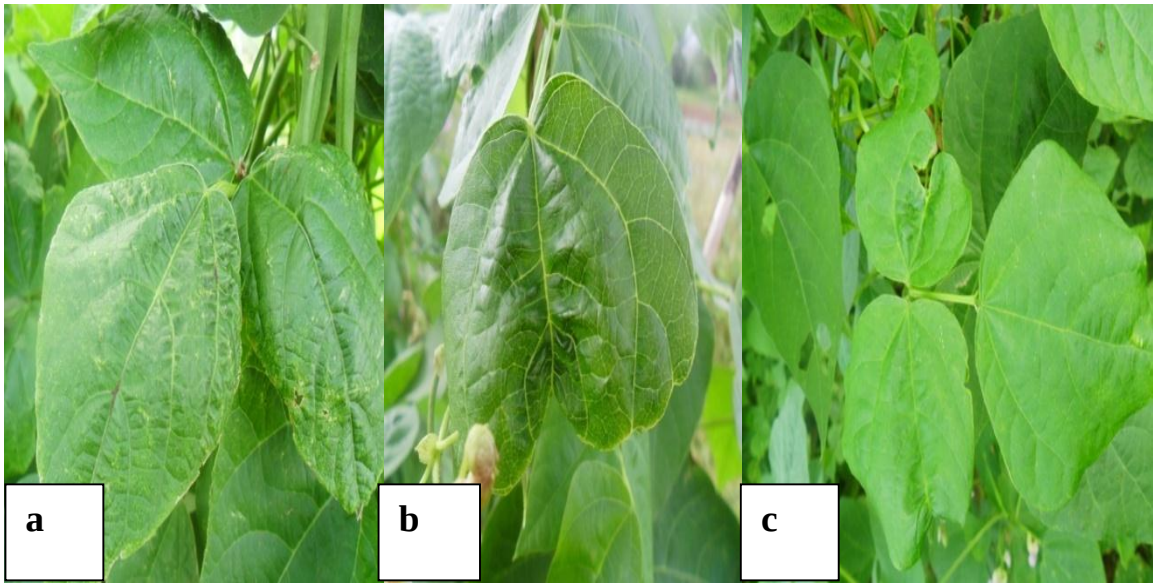

Figure. 3. Mottle on leaves of bean cultivar, a) Sadsadan cultivar, b) Burik cultivar, c) Alno/ Black valentine


Figure 4. Stunted symptoms of BCMV in maroon cultivar.

Incidence of Bean Rust

Among the cultivars, Sadsadan had significantly lower incidence of rust infection compared to the other 4 cultivars at 10.45. The cultivars Taichung and ALno/ Black valentine had significantly higher incidence of rust, (Table 4). The nature incidence and severity of symptoms greatly depending on cultivar, time of infection and environmental

conditions. French bean (*Phaseolus vulgaris*) is the common natural host, (Ainsworth 1940).

Table 3. Incidence of rust on bean cultivars

TREATMENT	MEAN	REACTION
Taichung	27.45[a]	Moderate susceptible
Maroon	20.63[a]	Moderate resistant
Burik	19.00[b]	Moderate resistant
Sadsadan	10.45[c]	Moderate resistant
Alno/ Black valentine	25.29[a]	Moderate susceptible
CV	13.10%	

Means followed by a common letter are significantly different at 1% level by DMRT.

Severity of Bean Rust

Reaction of bean cultivars against bean rustshows that different bean cultivars were infected with the virus. It was observe that cultivar Taichung and Alno/ Black valentine were moderately susceptible to rust while Maroon, Burik and Sadsadan were moderately resistant to rust. Among the cultivars, severity and reaction of bean cultivars in Sadsadan showed the lowest infection rating start at 25 to 60 days after planting. In addition, infection of the virus in cultivar Sadsadanwas relative slow (Figure 5).

The prevalence of bean rust infection was due favored by the temperature during the conduct of the study which ranged from 16.50ºC to 19.95ºC. Relative humidity of 86.31% and a rainfall of 3.18mm.

Table 3. Severity of bean rustinfection at different evaluation period

Cultivar	DAYS AFTER PLANTING						AUDPC
	46	53	60	67	74	81	
Taichung	4.20[a]	9.50[a]	15.70[a]	23.32[a]	28.42[a]	35.52[a]	765.80
Maroon	2.30[b]	5.07[b]	10.30[b]	16.33[b]	21.30[b]	26.32[b]	524.97
Burik	2.02[b]	4.57[c]	8.70[c]	15.32[c]	20.72[c]	25.00[c]	486.19
Sadsadan	0.50[c]	1.90[e]	3.10[e]	5.25[d]	10.00[e]	14.10[e]	210.00
Alno	1.90[b]	4.03[d]	7.93[d]	15.37[c]	17.52[d]	23.10[d]	443.31

Means followed by a common letter are significantly different at 1% level by DMRT.

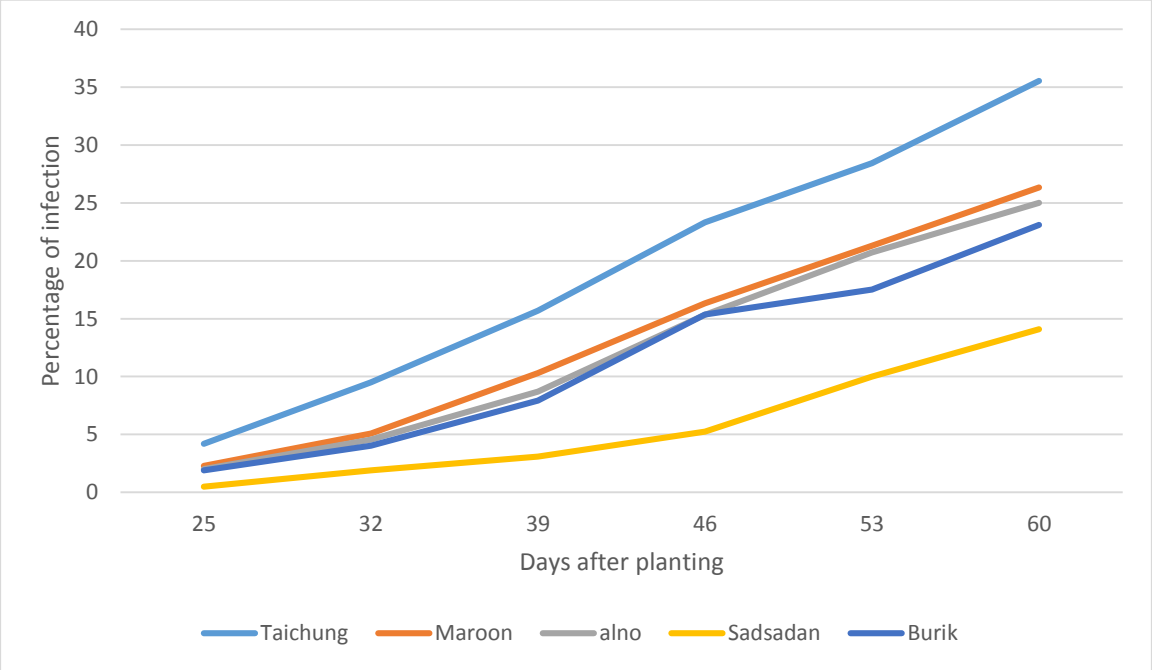

Figure 5. Severity of rus on bean cultivars.

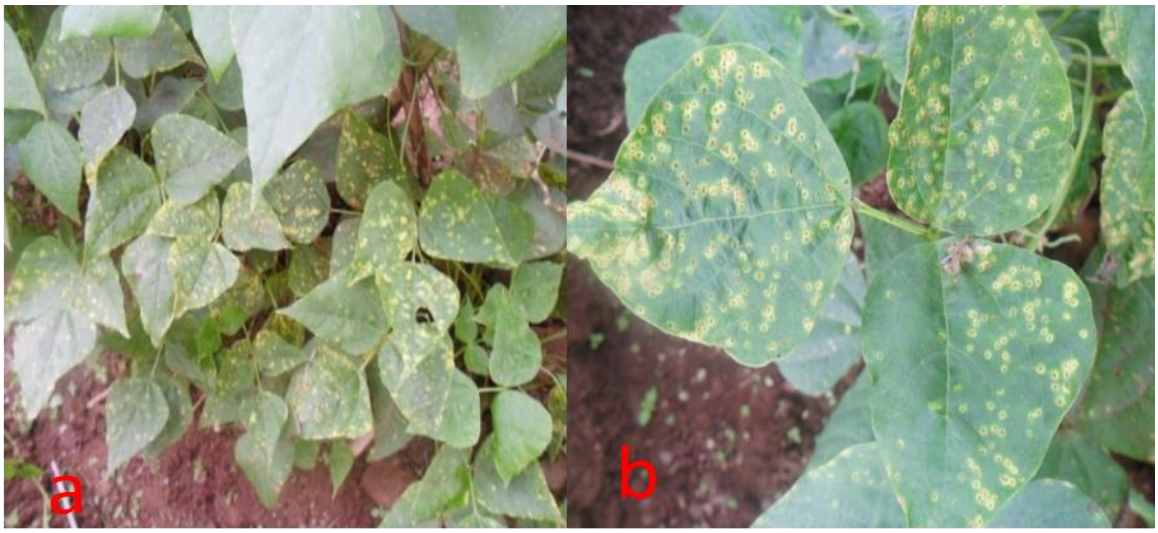

Figure 5. Bean rust on Taichung cultivar (a), maroon cultivar (b).

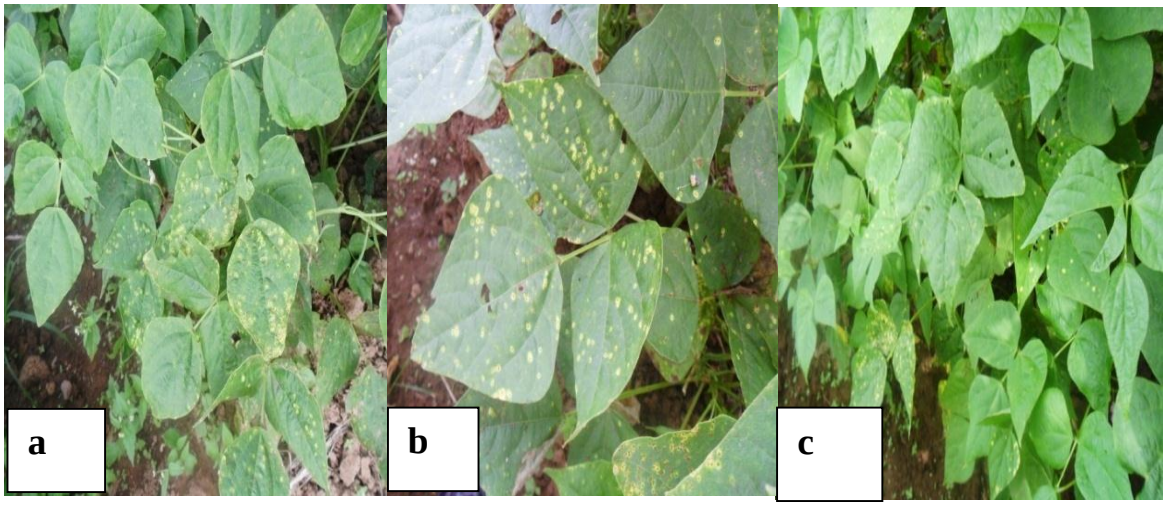

Figure 6.Moderately infection of bean rust in Burik cultivar (a), Alno/ black valentine cultivar (b), low infection of bean rust in Sadsadan cultivar.

Incidence of Bean Anthracnose

Cultivar Sadsadan had significantly the lowest bean incidence of anthracnose compared to the other cultivars with a mean of 6.25% (Table 3). The cultivar Taichung had the highest incidence of anthracnose which was not significantly different from the

mean incidence of anthracnose in the cultivars' Maroon and Alno/ Black valentine. Some characteristic that was observed in pods of Sadsadan was thick and fibrous. This can serve as defense mechanism of the plant to overcome the infection of the disease.

Table 5. Mean incidence of anthracnose on different bean cultivar

TREATMENT	MEAN	REACTION
Taichung	12.45[a]	Light resistant
Maroon	11.08[ab]	Light resistant
Burik	9.90[b]	Moderate resistant
Sadsadan	6.25[c]	Moderate resistant
Alno/ Black valentine	10.80[b]	Light resistant
CV	10.80%	

Means followed by a common letter are significantly different at 1% level by DMRT.

Severity of Bean Anthracnose on Bean Cultivar

Reaction of bean cultivars against bean anthracnose shows that different bean cultivars were infected with the disease. It was observe that cultivar Taichung, Maroon and Alno/ Black valentine were light resistant to anthracnose while Burik and Sadsadan were moderately resistant to anthracnose. Among the cultivars, severity and reaction of bean cultivars in Sadsadan showed the lowest infection rating start at 25 to 60 days after planting. In addition, infection of the anthracnose in cultivar Sadsadan was relative slow (Figure 7).

The prevalence of bean rust infection was due favored by the temperature during the conduct of the study which ranged from 16.50ºC to 19.95ºC. Relative humidity of 86.31% and a rainfall of 3.18mm.

The disease severity of the tested cultivars increased with time, with a high increase at pod formation (i.e., after 8 weeks from trifoliate leaves emergence), which indicates that the disease increases with plant age, presence of a susceptibility reaction at pod formation and prevailness of favorable environmental conditions (Rajappan, et al 2001).

Table 4. Mean severity of bean anthracnose on different bean cultivar

Cultivar	DAYS AFTER PLANTING						AUDPC
	46	53	60	67	74	81	
Taichung	2.40[a]	6.80[a]	12.32[a]	19.70[a]	28.27[a]	37.25[a]	904.65
Maroon	1.97[b]	4.70[a]	10.12[b]	17.07[b]	23.82[b]	31.07[b]	749.60
Burik	1.35[d]	3.25[b]	6.60[d]	11.22[d]	16.40[d]	21.90[d]	512.19
Sadsadan	0.27[e]	1.50[c]	3.10[e]	5.55[e]	9.90[e]	14.50[e]	293.55
Alno	1.80[c]	4.12[b]	8.42[c]	13.82[c]	19.25[c]	25.00[c]	611.84

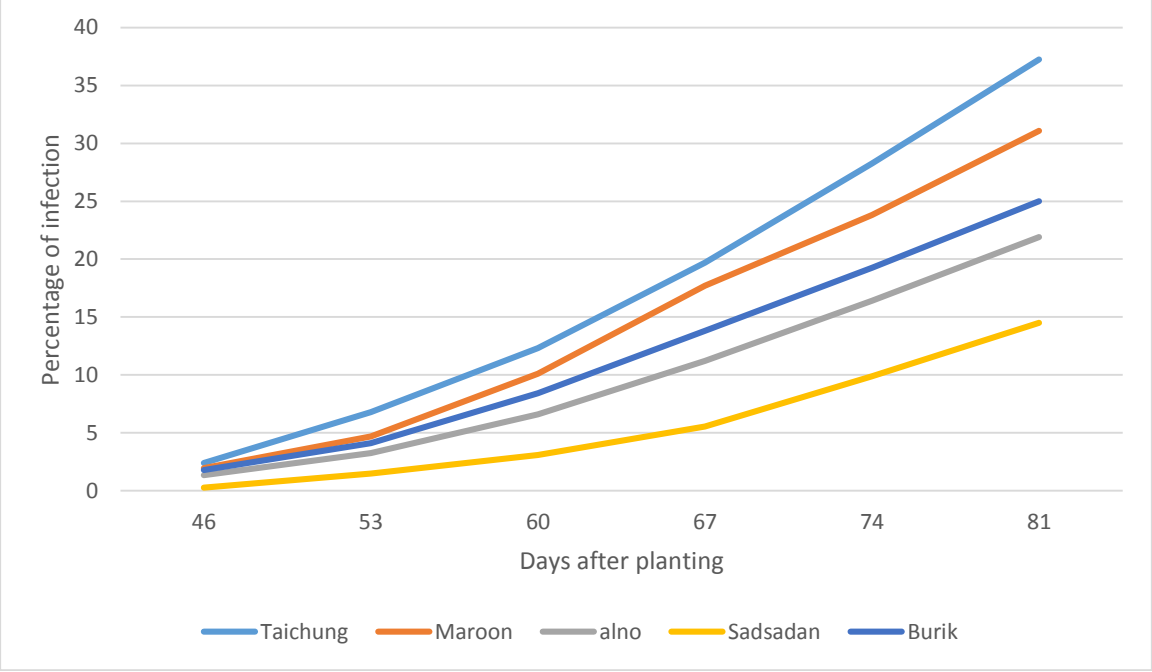

Figure 7. Severity of anthracnose on bean cultivar

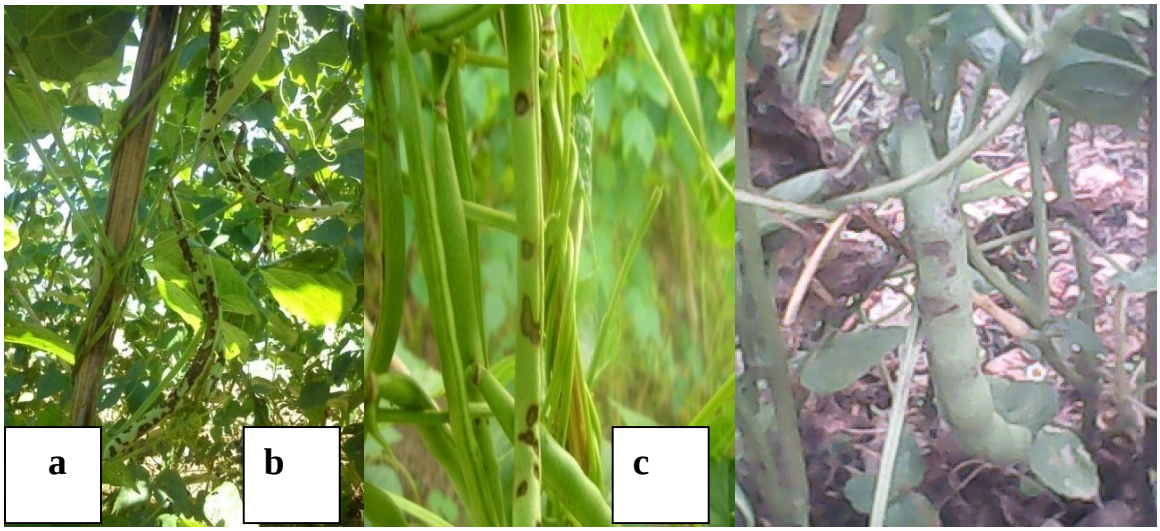

Figure 7.Infection of bean anthracnose on Taichung cultivar (a), Maroon cultivar (b), low infection of bean anthracnose in sadsadan cultivar (c).

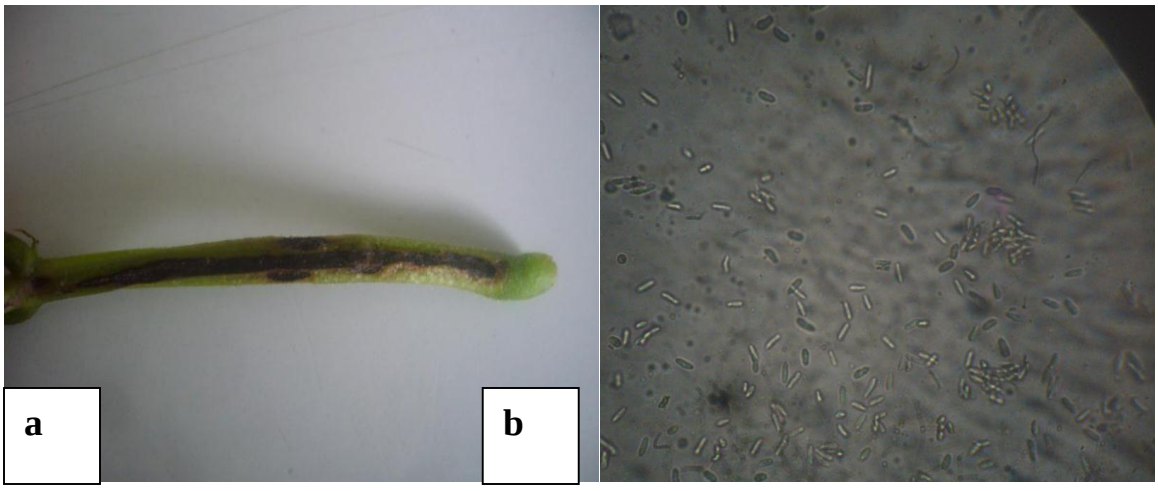

Figure 8. (a) Infection on leaf,(b)conidia (400x)

Incidence of Fusarium Root Rot
on Different Bean Cultivar

Infection not favorable to the Weather condition during the conduct of the study was not conducive to fusarium root rot. However, minimal infection in Taichung cultivar (Table 5).Favorable environmental for fusarium root rot include warm temperature (22-32°c), high soil moisture and acidic soils (Steadman, 1975).

Table 5. Incidence of fusarium on bean cultivars

TREATMENT	ACTUAL	TRANSFORMED
Taichung	1.80	2.51
Maroon	0.00	0.71
Burik	0.00	0.71
Sadsadan	0.00	0.71
Alno/ Black valentine	0.00	0.71
CV	86.66%	86.66%

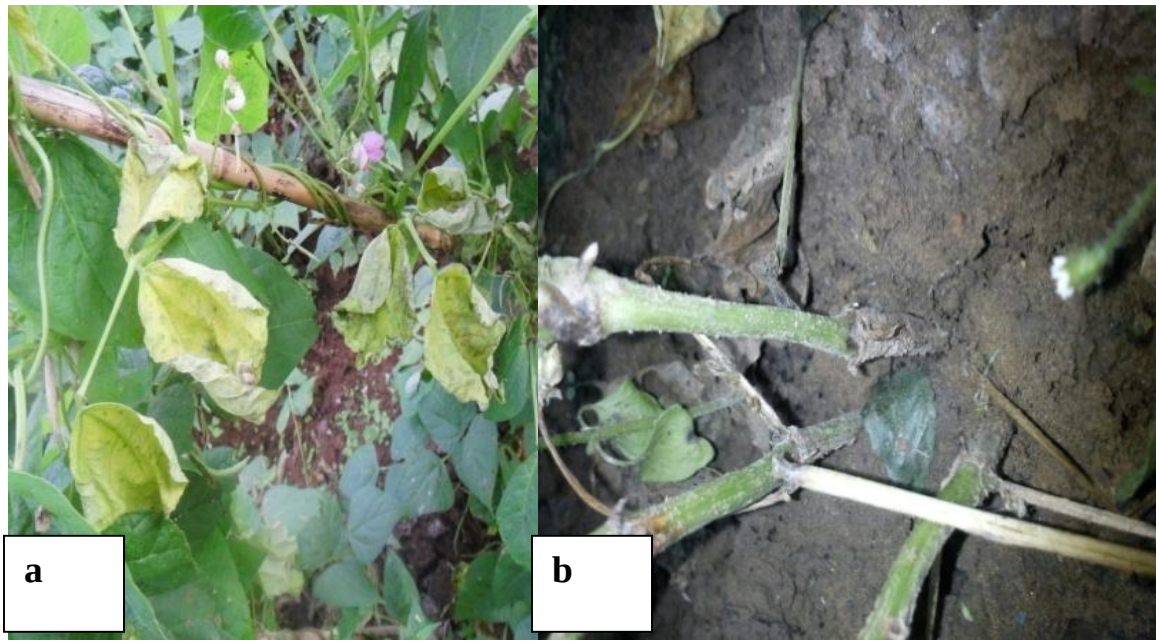

Figure 9. (a) wilting of plant, (b) resting spores on roots.

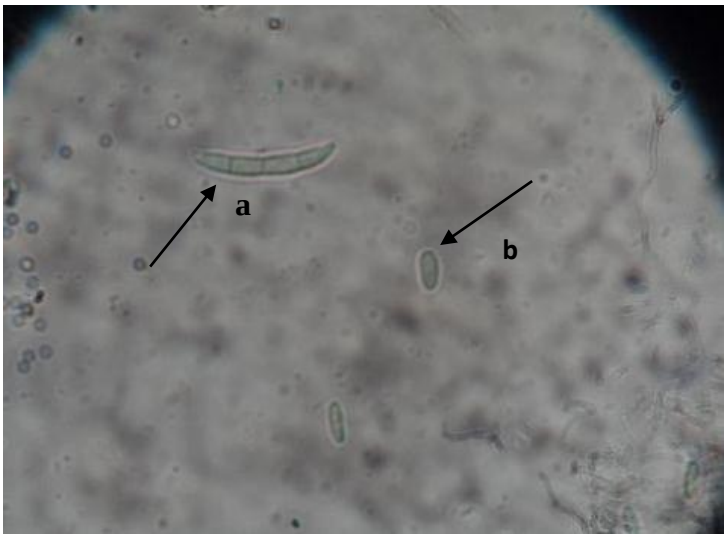

Figure 10. Conidia(a.macroconidia, b. microconidia) (400x)

Yield

Cultivar Maroon had significantly higher marketable yield tocomparedcultivarTaichungwhichhad the lowestyield(Table 7).Cultivartaichung had the highest non-marketable yield of the different bean cultivar and cultivarSadsadan had the lowest non-marketable yield (Table8).It was observed that Taichung had the highest severity of bean anthracnose. This can affect the non-marketable yield of the plant

Table 7. Marketable yield (tons/hectare) of bean cultivars

TREATMENT	MEAN
Taichung	4.33[b]
Maroon	6.02[a]
Burik	5.25[ab]
Sadsadan	5.64[ab]
Alno/ Black valentine	5.[15ab]
CV	17.11%

Means followed by a common letter are significantly different at 1% level by DMRT.

Table 8. Non- marketable yield on the different bean cultivar.

TREATMENT	MEAN
Taichung	2.98[a]
Maroon	1.53[b]
Burik	0.93[b]
Sadsadan	0.83[b]
Alno/ Black valentine	1.25[b]
CV	40.19%

Means followed by a common letter are significantly different at 1% level by DMRT.

Table 9. The Temperature, Relative Humidity and Rainfall from September 2012 to December 2012

MONTH	TEMPERATURE ºC	RELATIVE HUMIDITY %	RAINFALL (mm)
September	19.95	89.00	9.20
October	18.65	85.00	2.10
November	16.50	84.75	1.33
December	16.90	68.50	0.10
Mean	1118	86.31	3.18

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

Five cultivars of pole snap beans were evaluated for of the foliage diseases and root diseases under Balili, La Trinidad Benguet. Condition results showed that cultivar Taichung was highly susceptible to bean anthracnose, bean rust, and fusarium root rot. The cultivar Sadsadan was highly resistant to these diseases. The cultivar Maroon was susceptible to bean common mosaic virus while alno/ black valentine was the resistant to the disease. In terms of yield, Maroon had the highest marketable yield and Burik had the lowest marketable yield.

Conclusions

Among the five cultivar of bean, it was found that cultivar Sadsadan had some sort of resistance against bean rust and bean anthracnose. Alno/ Black valentine cultivar had some sort of resistance to bean common mosaic virus.

Recommendations

Cultivar Sadsadan were recommended to minimize losses and it is resistant to bean rust and bean anthracnose. The cultivar maroon was also recommended since it was tolerance to the diseases.

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