Original Research Article

Influence of weed management practices in correlation and regression studies between weed attributes, growth, yield attributes of transplanted Pearl millet (*Pennisetum glaucum* (L.) R. Br. Emend. Stunz)

ABSTRACT:

Aim: To evaluate the "Influence of weed management practices in correlation and regression studies between weed attributes, growth, yield attributes of transplanted pearl millet (*Pennisetum glaucum* (L.) R. Br. Emend. Stunz)".

Study Design: Randomized Complete Block Design (RBD).

Place and Duration of Study: The field trial was conducted during the *Rabi* season 2022 at Experimental farm, Karunya Institute of Technology and Sciences, Coimbatore, Tamil Nadu.

Methodology: The experiment consisted of eight different treatments for weed management practices was replicated thrice. The soil type used was silty clay loam. The Pearl millet TNAU cumbu hybrid (CO9) was sown in the nursery and transplanted at 18 DAS and transplanted with a spacing of 45 x 15 cm. The following treatments were applied: T_1 - PE of Atrazine 0.5 kg ha^{-1}, T_2 - PE of Oxyflurofen 0.250 kg ha^{-1}, T_3 - PE of Pendimethalin 0.75 kg ha^{-1}, T_4 - T1+ Hand Weeding on 30 DAT, T_5 - T2+ Hand Weeding on 30 DAT, T_6 - T3+ Hand Weeding on 30 DAT, T_7 - Hand Weeding on 20 and 40 DAT and T_8 - Unweeded check.

Result: The analysis showed positive correlation between grain yield and growth parameters *viz.,* plant height at harvest (r = 0.965), LAI at 45 DAT (r = 0.852), DMP at 45 DAT (r = 0.971) and DMP at harvest (r = 0.973). Grain yield showed positive correlation with yield attributes, WCE and nutrient content *viz.,* Productive tillers (r = 0.987), test weight (r =0.994), stover yield (r = 0.981), Weed Control Efficiency (r = 0.931), nitrogen uptake (r = 0.980), phosphorous uptake (r = 0.979) and potassium uptake (r = 0.962).

Keywords: Correlation, regression, Pearl millet and weed management

1.INTRODUCTION

Millets are popularly known as nutri cereals as they are the storehouse of nutrients. Among which Pearl millet (*Pennisetum glaucum* (L.) R. Br. Emend. Stunz) is a significant crop used for both food and fodder. It can be cultivated either by transplanting or direct seeding, and it is suitable for both irrigated and rainfed conditions. Pearl millet originated from Africa and belongs to the poaceae family. It is globally recognized as the 6th most important cereal crop, while in India, it holds the 4th position among the most important cereal crops

The pearl millet crop is cultivated over 6.93 m ha area with an average production of 8.61 m t and productivity of 1243 kg ha^{-1} [1]. Rajasthan, Maharashtra, Gujarat, Uttar Pradesh, and Haryana are the primary states in India where pearl millet cultivation is predominant. These states collectively contribute to over 90 per cent of the total pearl millet production in the country. Pearl millet plays a crucial role in ensuring food and nutritional security due to its numerous advantages, including early maturation, tolerance to drought, and resilience against biotic and abiotic stresses. A significant portion of pearl millet grain is also used for non-food purpose such as poultry feed, cattle feed and alcohol extraction [3]. It is a highly cross-pollinated crop due to its protogynous nature of flowers. Pearl millet grain contains a fairly high amount of thiamine, riboflavin and niacin. In general, pearl millet has more fat and protein content than sorghum. The energy level (784 cal kg^{-1}) is among the highest for whole grain cereals by Yawatkar et al.[10].

Weed infestation in pearl millet is one of the major constrains which limits the productivity. Prajapathi et al. [7] noticed that diversity of weeds competing with the crops progressively becoming a major hindrance to the development of pearl millet. On an average 55% of yield reduction due to heavy weed infestation in pearl millet was observed by Banga [2]. There is wide variety of weeds like *like Dactylotenium aegyptium, Echinochloa colona, Trianthema portulacastrum, Cyperus rotundus, Amarathus viridis, Amaranthus spinosus, Cyperus spp., Euphorbia spp., Cynodon dactylon, Tribulus terrestris, Digitaria sanguinalis, Parthenium hysterophorus* were found infesting the crop were found infesting the field. With this perspective in mind, the aim is to investigate the different characters that influence grain yield in pearl millet, including growth attributes and yield attributes, as well as identifying the weed attributes that affect grain yield.

2. MATERIALS AND METHODS

2.1. Experimental location and climatic condition

The field trial was conducted during during the *Rabi* season of 2022 at experimental Farm, Karunya Institute of Technology and Sciences, Coimbatore. The soil composition of the experimental plot was characterized as silty clay loam, with a pH value of 5.36 and an electrical conductivity (EC) of 0.06 dS/m. The specific location of the experimental site situated in Western agro-climatic zone of Tamil Nadu, with geographical coordinates at 10°56'N latitude and 76°44'E longitude. The mean sea level is around 474 meters. During the cropping period, the minimum and maximum temperatures ranged from 26.71 to 19.64□ respectively. The total rainfall received during the cropping period in 2022-2023 was 776.15 mm. The mean RH ranged from 87.95 per cent.

2.2. Experimental design and treatment details

The experiment was designed using a Randomized Block Design (RBD) with a total of eight treatments and three replicates. The treatments are T_1 **-** PE of Atrazine 0.5 kg ha^{-1}, T_2 - PE of Oxyflurofen 0.250 kg ha^{-1}**,** T_3 - PE of Pendimethalin 0.75 kg ha^{-1}**,** T_4 **-** T1+ Hand Weeding on 30 DAT**,** T_5 **-** T2+ Hand Weeding on 30 DAT**,** T_6 **-** T3+ Hand Weeding on 30 DAT**,** T_7 **-** Hand Weeding on 20

&40 DAT and T_8 **-** Unweeded check**.**

2.3. Crop management

The field was prepared thoroughly using a tractor-drawn rotavator to achieve a fine tilth, followed by levelling. The seeds were sown in the nursery in raised beds and all the appropriate agronomic management practices were followed and transplanted in the main field with the spacing of 45 x15 cm. Additionally, all the weed management treatments were diligently applied.

2.4. Statistical analysis

We performed computations to evaluate the relationship, correlation, and regression coefficients between the grain yield of pearl millet (Y) and independent variables (X) including weed density, weed dry matter, crop dry matter accumulation, yield attributes, nutrient depletion by weeds, and nutrient uptake by the crop using the method describer by Snedecor and Cochran [9]. Additionally, simple linear regression equations which was given by Panse and Sukhatme [6] were calculated for the various growth parameters, yield attributes, yield, and nutrient uptake.

3. RESULTS

3.1. Correlation

The Grain yield was significantly and highly positively correlated with stover yield (r = 0.981), plant height at harvest (r =0.965), LAI at 45 DAT (r =0.852), DMP at 45 DAT (r =0.971), DMP at harvest (r =0.973), Productive tillers (r =0.987), test weight (r =0.994), Weed Control Efficiency (r =0.931), nitrogen uptake (r =0.980), phosphorous uptake (r =0.979) and potassium uptake (r =0.962). Conversely, it was highly negatively correlated with weed density at harvest (r =0.931), weed dry weight (r =0.931), nitrogen removal (r =0.985), phosphorous removal (r =0.905) and potassium removal (r =0.985). It was also negatively correlated with weed density at 15 DAT (r =0.773) and weed density at 45 DAT (r =0.789) as shown in table 1.

Stover yield was significantly and highly positively correlated with plant height at harvest (r =0.945), LAI at 45 DAT (r =0.844), DMP at 45 DAT (r =0.991), DMP at harvest (r =0.991), Productive tillers (r =0.979), test weight (r =0.977), Weed Control Efficiency (r =0.924), nitrogen uptake (r =0.950),

Table. 1. correlation coefficient between weed attributes, growth, yield components and yield of pearl millet.

Parameters	GY	ST	PH	LAI 45	DMP 45	DMP Har	P.Tillers	Test wt	W. Den 15	W. Den 45	W. Den Har	W. Dry wt	WCE	N rem	P rem	K rem	N uptake	P uptake	Kuptake
GY	1																		
ST	0.981**	1																	
PH	0.965**	0.945**	1																
LAI 45	0.852**	0.844**	0.908**	1															
DMP 45	0.971**	0.991**	0.956**	0.872**	1														
DMP Har	0.973**	0.991**	0.939**	0.884**	0.981**	1													
P.Tillers	0.987**	0.979**	0.947**	0.837**	0.975**	0.970**	1												
Test wt	0.994**	0.977**	0.973**	0.865**	0.972**	0.975**	0.988**	1											
W. Den 15	-0.773*	-0.774*	-0.720*	-0.584	-0.813*	-0.717*	-0.802*	-0.745*	1										
W. Den 45	-0.789*	-0.805*	-0.894**	-0.955**	-0.835**	-0.832*	-0.781*	-0.811*	0.5	1									
W. Den Har	-0.931**	-0.924**	-0.978**	-0.937**	-0.948**	-0.920**	-0.926**	-0.933**	0.753*	0.932**	1								
W. Dry wt	-0.931**	-0.924**	-0.978**	-0.937**	-0.948**	-0.920**	-0.926**	-0.933**	0.753*	0.932**	1**	1							
WCE	0.931**	0.924**	0.978**	0.937**	0.948**	0.920**	0.926**	0.933**	-0.753*	-0.932*	-1**	-1**	1						
N rem	-0.985**	-0.965**	-0.977**	-0.850**	-0.954**	-0.953**	-0.971**	-0.981**	0.725*	0.830*	0.950**	0.950**	-0.950**	1					
P rem	-0.905**	-0.898**	-0.961**	-0.926**	-0.931**	-0.888**	-0.900**	-0.903**	0.776*	0.923**	0.996**	0.996**	-0.996**	0.924**	1				
K rem	-0.985**	-0.968**	-0.971**	-0.849**	-0.951**	-0.962**	-0.973**	-0.985**	0.692	0.827*	0.936**	0.936**	-0.936**	0.997**	0.903**	1			
N uptake	0.980**	0.950**	0.964**	0.884**	0.955**	0.951**	0.987**	0.986**	-0.771*	-0.819*	-0.945**	-0.945**	0.945**	-0.968**	-0.921**	-0.968**	1		
P uptake	0.979**	0.938**	0.946**	0.823*	0.928**	0.934**	0.982**	0.982**	-0.737*	-0.762*	-0.908**	-0.908**	0.908**	-0.973**	-0.876**	-0.977**	0.989**	1	
K uptake	0.962**	0.912**	0.964**	0.863**	0.906**	0.914**	0.955**	0.968**	-0.675	-0.823*	-0.933**	-0.933**	0.933**	-0.976**	-0.904**	-0.977**	0.980**	0.987**	1

**** - Significant at 1 %; * - Significant at 5 %**

Note: GY(grain yield kg ha^{-1}), SY (stover yield kg ha^{-1}),PH (Plant height at harvest stage- cm), DMP at 45 DAT and harvest stage (Dry matter production at 45 DAT and at harvest stage kg ha^{-1}), P.tillers (Productive tillers^{-1}), Test wt (test weight g), W. DEN 15, 45 and har (weed density at 15 , 45 DAT and at harvest no / m^{2}), W. Dry wt (weed dry weight Kg ha^{-1}), N rem (Nitrogen removal by weeds kg ha^{-1}), P rem (Phosphorous removal by weeds kg ha^{-1}) and K rem (Potassium removal by weeds kgha^{-1})

**P<0.05; **P<0.01 are the probability levels for significant of Pearson correlations (two tailed).*

Table 2. Regression coefficients (b values) and intercept (a) of different component traits on grain yield of pearl millet along with their coefficient of determination (R^2)

Characters	Intercept (a)	Regression coefficients (b values)	R^2	Regression equation Y= a+ bx
Stover yield	186.27	0.60	0.963**	$Y= 186.27 + 0.60\ X_1$
Plant height at harvest	-3145.22	38.66	0.932**	$Y= -3145.22 + 38.66\ X_2$
LAI at 45 DAT	19.36	723.98	0.725**	$Y= 19.36 + 723.98\ X_3$
DMP at 45 DAT	123.53	0.95	0.944**	$Y= 123.53 + 0.95\ X_4$
DMP at harvest	527.49	0.43	0.947**	$Y= 527.49 + 0.43\ X_5$
Productive tillers	-911	1022	0.974	$Y= -911+ 1022\ X_6$
Test weight	-124056.02	9139.84	0.989	$Y= -124056.02 +9139.84\ X_7$
Weed density at 15 DAT	3122.24	-15.82	0.597*	$Y= 3122.24 -15.82\ X_8$
Weed density at 45 DAT	3126.88	-14.81	0.623*	$Y= 3126.88 -14.81\ X_9$
Weed density at harvest	3361.68	-18.87	0.868**	$Y= 3361.68 -18.87\ X_{10}$
Weed dry weight	3361.68	- 0.47	0.868**	$Y= 3361.68- 0.47\ X_{11}$
WCE	998.50	23.63	0.868**	$Y= 998.50+23.63\ X_{12}$
N removal by weeds	3684.05	-42.01	0.971**	$Y= 3684.05-42.01\ X_{13}$
P removal by weeds	3257.60	-183.36	0.818**	$Y= 3257.60-183.36X_{14}$
K removal by weeds	3715.61	-46.56	0.971	$Y=3715.61 -46.56\ X_{15}$
N Uptake by crop	-2198.03	70.55	0.960**	$Y= -2198.03 +70.55\ X_{16}$
P Uptake by crop	-92.53	87.13	0.958**	$Y= -92.53 + 87.13\ X_{17}$
K Uptake by crop	-457.72	82.49	0.926	$Y= -457.72 + 82.49\ X_{18}$

**P<0.05; **P<0.01 are the probability levels for significant of Pearson correlations (two tailed).*

phosphorous uptake (r = 0.938) and potassium uptake (r = 0.912). Conversely, it was highly negatively correlated with weed density at harvest (r = 0.924), weed dry weight (r = 0.924), nitrogen removal (r =0.965), phosphorous removal (r = 0.898) and potassium removal (r = 0.968).

3.2. Regression

The regression studies in table 2 showed that every unit increase in weed density at 15 DAT, weed density at 45 DAT, weed density at harvest, weed dry matter, N, P and K depletion by weeds at harvest stage decreased the grain yield of pearl millet by 0.597, 0.623, 0.868, 0.868, 0.971, 0.818 and 0.971 kg ha^{-1} respectively. On the other hand, every unit increase in Stover yield, plant height, LAI 45, crop dry matter at 45 DAT, crop dry matter at harvest, number of productive tillers $plant^{-1}$, test weight, WCE and N, P and K uptake by crop substantially increased the grain yield by 0.963, 0.932, 0.725, 0.944, 0.947, 0.974, 0.989, 0.868, 0.960, 0.958 and 0.926 kg ha^{-1} respectively.

Discussion

The correlation and regression studies revealed that the grain yield was positively influenced by growth attributes *viz.,* plant height, number of tillers, LAI and DMP. It was observed that the implementation of improved weed management practices led to a reduction in crop-weed competition, competition for essential resources such as moisture, light, space, and nutrient. This in turn increased cell division and elongation and multiplication resulting in increase in plant height thereby resulted in increase of number of tillers It corroborates the findings Chaudhary et al. [4]. Since the increased plant height and number of tillers the crop biomass will also increase which is clear that crop dry matter accumulation will also increase. This is depicted in fig 1. This improvement was evident in terms of better development of reproductive structures and enhanced translocation of photosynthates into sink. It is consistent with the findings of Samota et al. [8]. According to regression study the grain yield was positively influenced by stover yield. Due to increase in crop dry matter accumulation the stover yield is increased.

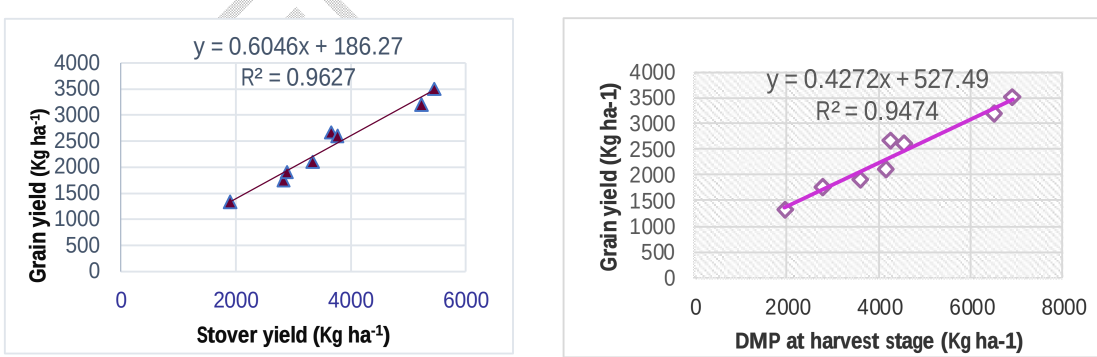

Fig 1. Positive Linear regression relationship of grain yield (Kg ha^{-1}) with stover yield (Kg ha^{-1}) and DMP at harvest stage (Kg ha^{-1})

It also exposed that the grain yield was highly negatively influenced by weed density, weed dry weight and nutrient removal. The coefficient of determination (R^2) was 0.868, 0.868, 0.971 and 0.818 which indicated 86.8 %, 86.8%, 97.1% and 81.8% variation in grain yield was due to weed density at harvest, weed dry weight at harvest, nitrogen and phosphorous removal by weeds. This is presented in fig 2. This could be due to heavy weed infestation robbed crop of common essential resources from early- stage onwards. Hence, crop deprived of resources could not grow to its full potential that ultimately reduced grain yield. It aligns with the findings of Nibhoria et al. [5].

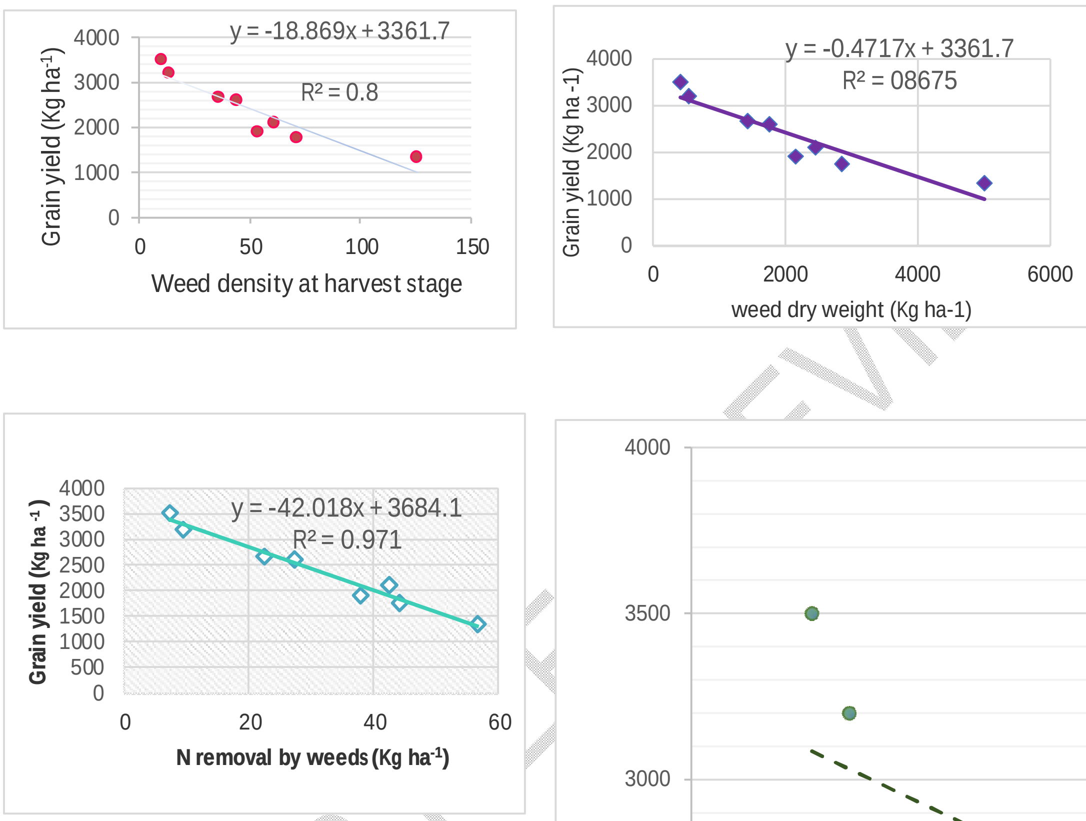

Fig 2. Negative Linear regression relationship of grain yield (Kg ha^{-1}) with weed density at harvest stage, weed dry weight harvest stage (Kg ha^{-1}), Nutrient removal by weeds (Kg ha $^{-1}$)

The studies further indicated that the grain yield was positively influenced by nutrient uptake and weed control efficiency. This positive impact was attributed to the efficient weed management practices, which effectively controlled weed growth. As a result, there was reduced competition between the cultivated plants and weeds for essential nutrients. This improved weed control efficiency allowed the plants to uptake more nitrogen and phosphorous, leading to increased crop biomass. Ultimately, these factors collectively influenced the grain yield positively.

From the above discussion it is evident that the DMP at harvest (R^2=0.947), Nitrogen uptake (R^2= 0.960), phosphorous uptake (R^2= 0.958) and stover yield (R^2=0.963) significantly and highly positively influenced the grain yield.

4. Conclusion

The utilization of regression and correlation studies has facilitated the formulation of a robust conclusion regarding the parameters that have a positive or negative impact on grain yield. The correlation analyses revealed that the grain yield was highly negatively affected by weed density at 15, 45 DAT and at harvest, weed dry weight and nutrient removal by weeds. Though the WCE give a positive influence to the grain yield. Therefore, the efficient weed management is necessary to increase the grain yield of pearl millet.

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