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Effectiveness of weed management practices in groundnut (*Arachis hypogaea*)

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ABSTRACT

A field experiment was conducted in pre-monsoon season during 2017 and 2018 at National oil seed research program, Nawalpur, Sarlahi, Nepal, to study the impact of weed management practices in groundnut production. Pendimethalin as pre-emergence, while Metribuzin, Propaquizafop at 100 g per hectare, Quizalofop ethyl at 100 g per hectare, as post emergence was used along with integration with hand weeding and intercultural operation. The result revealed that supplement of the hand weeding after the application of the pre-emergence herbicides pendimethalin was found effective in reducing the weed severity and improves the growth and yield attributes and ultimately yielded 2101 kg ha^{-1}. This treatment also recorded the highest gross and net return (NRs 168080 and 48470) and benefit cost ratio (1.4) thus, this integrated weed management practice could become effective and economic under southern belt terai agro climatic condition of Nepal.

Introduction

An important food and cash crop, Groundnut (*Arachis hypogaea* L.), has reserved its position due to its both domestic and export markets importance being the fourth most important oilseed crop and second most important source of vegetable oil in the world (Guchi, 2015; Kombiok et al., 2012). However, its production level is still minimal in spite of increasing world's market which may be due to many other hindrance factors being centered as depletion of the organic matter content and disease, pests and weed infestation.

According to Upadhyay (1984), weeds vigorously compete with the groundnut plant for resources (sunlight, space, moisture, and nutrients) not only during the growing season but also in

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the latter period during digging and inverting procedures reducing harvesting efficiency, ultimately lowering the yield. Apart from reduced harvesting, they also intensify the disease and insect pest problem by serving as alternative hosts even possessing the allelopathic effect on the crop (Bansal, 1993). Initial growth of the crop is generally characterized by relatively shallow canopy slowly shadowing the inter-row area facilitating bumper weeds growth making the crop more susceptible in competition with the weeds. Wesley et al. (2008) reported that the critical period of grass weed control was found to be from four to nine weeks after planting which was between two to eight weeks for the broad leaved weeds. Thus, early management of weeds within 3–6 weeks after planting is important in groundnut production because the crop is not able to compete effectively with weeds, particularly before flowering and during pegging. Zimdhal (2004) also quoted that Groundnut yield decreased with increasing time of weed interference with all type of weed species. Early good weed control together with other agronomic practices if followed, promotes vigorous crop growth that can suppress subsequent weed growth (El Naimet al., 2010) especially crop cultivars with running growth habit.

There are various methods for weed control like cultural, physical, biological and chemical, each being more suitable than others for use in specific crop, time and location. Since, cultural methods are laborious, time consuming and getting more expensive as it will merely be possible and economical to stick to only traditional practices (Nadeem et al. 2008), unlike the mentioned method, chemical control method is quick, more effective, time and labor saving method (Ahmad et al. 2004).However there are some negative effects including the environmental pollutions, animal and human risks as well as impacts on non-target organisms (Mehdizadeh et al. 2020). Thus the present investigation was attempted to identify effective and economically viable method of weed control for augmenting the productivity of groundnut crop and harvesting higher yield.

Materials and Methods

Field research was conducted in the research block of NORP(National Oilseed Research Program) Nawalpur, Sarlahi during the summer season (July-October, 2017 and 2018 respectively), situated in Terai of Nepal lying at 27° 03’ 86” north latitude and 85° 35’ 52” east longitude at an elevation of 144 meter above mean sea level. The soil test report of experimental plot was sandy loam textured with soil pH ranging between 4.5 -6.0 consisting 1.34% organic matter and the soil contains total nitrogen 0.051%, available P_2O_5 172 kg ha^{-1} and K_2O 205 kg ha^{-1}. The result indicates low level of Nitrogen, high Phosphorus and medium Potassium.

Experiment was carried out in Randomized Completely block Design with nine treatments viz. pendimethalin follow by one hand weeding, Metribuzin follow by one hand weeding, Propaquizafop

at 100 g a.i ha^{-1} at 20-25 DAS, Quizalofop ethyl at 100 g a.i ha^{-1} at 20- 25 DAS, Pendimethalin follow by Propaquizafop at 100 g a.i ha^{-1} at 20-25 DAS, Pendimethalin follow by Quizalofop ethyl at 100 g a.i ha^{-1} at 20- 25 DAS, Cover mulch(groundnut pod shell) ,Farmers practices (1 Hand weeding + 1 intercultural operation), unweeded control replicated three times constituting twenty seven plots. The field was ploughed 15 days prior to sowing and seeds of Sambridhi variety of groundnut were planted by jab planter in furrows at spacing of 10 cm within plant and 30 cm within row with plot size of $10m^2$ by the help of tractor drawn opener. In case of control plot, weeds were allowed to grow along with groundnut throughout the crop cycle, but in weed free treatment, weeding was done manually to keep the plots free from weeds. The crop was raised under irrigated condition as per as recommended package of practices. Densities and dry weight of weeds were recorded before and after post emergence application and were subjected to log transformation before analysis. Growth and yield characters were recorded as per standard procedures and calculated using standard formulas which were tabulated in Microsoft Excel 2007 and analyzed by Genstat version 18.

Results and Discussion

Effect of weed management in phenological parameters of groundnut

The flowering days were earlier in weed free condition over control plot because application of the pre and post emergence herbicides and mulching promote the early flowering in the same varieties whereas, post-emergence herbicides and hand weeding practice shows mere influence enhancing the flowering days little earlier than the control situation. Similarly, maturity days were hastened in the weed affected plot than weed free condition. Also, pre and post emergence herbicides promote early maturity, for instance, earlier maturity was found in pendimethalin applied field followed by hand weeding. The plant height showed the significant effect with weed management practices. The pod shell mulch provides the sufficient resources in the field regarding soil moisture conservation, preventing from the direct exposure of sunlight and encourages weed suppression that enhance the development of plant height. Not only weed severity, the factor in reducing the plant height, its control plot had intermediate result regarding plant height and farmer management and post application with hand weeding has least than other treatment.

The weed control methods show significant effect on the yield and yield attributes where pod formation showed the positive response to weed management practices. The pre-emergent herbicides and hand weeding revealed to highest pod number and followed by the post emergent herbicides applied with one hand weeding, farmer practices and shell mulch and least was found in

control, Propaquizafop, Quizalofop ethyl, Pendimethalin + Propaquizafop and Pendimethalin + Propaquizafop and Pendimethalin+ Quizalofop ethyl.

Table 1. Effect of weed management in phenological parameter of groundnut.

Weed management methods	Days of flowering (DAS)	Days of maturity(DAS)	Plant height (cm)	Pod per plant
Pendimethalin+HW	25[c]	126[f]	60.3bc	35a
Metribuzin+HW	26[d]	130[b]	56c	29b
Propaquizafop at100g per ha	28[c]	128[d]	60.3bc	15de
Quizalofop ethyl at100 g a.i	28[c]	131[a]	60bc	14de
Pendimethalin + Propaquizafop	25[e]	129[c]	63.6ab	16cde
Pendimethalin+ Quizalofop ethyl at 100 g a.i	25[e]	129[c]	60.3bc	12e
Groundnut pod shell mulch	28[c]	131[a]	66a	21c
Farmer practice (1 hand weeding+ 1 IO)	29[b]	130[b]	56.6c	27b
Control plot	32[a]	131[a]	64ab	17cd
Grand mean	27	130	60.8	20.67
SEm (±)	0.26	0.254	1.652	1.473
LSD(0.05)	0.76*	0.72**	4.72	4.211
CV(%)	2.4	0.5	6.7	17.5

*significant at 5% level of significance, ** highly significant at 1% level of significance

Effect of weed management in yield and yield attributes of groundnut

The highest shelling percentage and grain yield was found in Pendimethalin applied followed by hand weeding and metribuzin followed by hand weeding over the other treatment where, 100-seed weight was found the highest in control plot followed by ground shell mulch but very least in farmer practice and Pendimethalin+ Quizalofop ethyl. The highest grain yield was found in pendimethalin and followed by one hand weeding which might be due to higher shelling percentage and reduced weed competition for limited resources resulting in increase of matured number of pods per plant compared to other treatment (Olorunmaiye and Olorunmaiye, 2009). The supplementary hoe-weeding after the application of Pendimethalin could provide the long weed control besides suppressing further fresh flush of weeds which were emerged early. Similarly, used of metribuzin followed by hand weeding stands second in grain yield, followed by farmer practice (one hand weeding+ one IO) and the least in control plot. The groundnut shell mulch could not contributed the significant yield over other control which is found in contradict to the opinion of Singh and Joshi (1993) and (Bolaji and Emmanuel, 2016) which reported suppression of weed to some extent. If chemical means are to be employed solely for weed control in the initial phase, the

herbicides must provide sufficient control to keep the fields weed free during the critical period of competition at 30-45 DAS. Since pre-emergent herbicides dissipate over time, and late emerging and herbicide tolerant weeds have been shown to cause yield reductions (Rathi et al., 1986), integration of chemical and manual methods will provide full season weed control, including herbicide tolerant and late emerging weeds. Furthermore, manual weeding prior to gynophores establishment facilitate entry and development of gynophores of groundnut in the loose soil. Thus, the use of the herbicides along with manual weeding not only controlled the weeds effectively but also provided weed free condition for longer period of time.

Table 2. Effect of weed management in yield and yield attributes of groundnut.

Treatment	Shelling (%)	Grain Yield (kg/ha)	Test weight
Pendimethalin+HW	79a	2101a	46.5bcd
Metribuzin+HW	77.33ab	1903a	45cd
Propaquizafop at100g	76bc	1276bcd	46.5bcd
Quizalofop ethyl at 100 g a.i	74.67cd	1170cd	49abc
Pendimethalin + Propaquizafop	75cd	1435bc	49abc
Pendimethalin+ Quizalofop ethyl at 100 g a.i	75cd	1369bc	42.67d
Groundnut pod shell mulch	76bc	978cd	50ab
Farmer practice (1 hand weeding+ 1 IO)	77.33ab	1695ab	44d
Control plot	73.67d	860d	51.67a
Grand mean	76	1421	47.15
SEm (±)	0.57	146.1	1.45
LSD(0.05)	1.63**	417.5**	4.16*
CV(%)	1.9	25.2	7.6

*significant at 5% level of significance, ** highly significant at 1% level of significance

Effect of weed management practice in weed abundance in groundnut

Severity of the broad leaf and narrow leaf differs with weed management practices in groundnut. Higher number of broad leaf and narrow leaf species were available in field where Propaquizafop at 100 g a.i. ha^{-1} was applied as post emergence. Total number of weed was found higher in farmers practice followed by the control plot. After the application of the post emergent herbicides and post hand weeding, the abundance of weeds was greatly reduced but less control in Quizalofop ethyl at 100 g a.i. ha^{-1} and seen less variation in control. The competition within weeds suppresses the population in some extent. Moreover, 50% reduction in total weed was found in the pendimethalin followed by hand weeding and 75% below reduction weeds in farmer practices. Pre-emergent weeds were significantly found higher in Quizalofop ethyl at 100 g a.i. ha^{-1} but very less in pendimethalin with hand weeding and metribuzin with hand weeding which reduced to half. Moreover, the weed infestation was higher in farmer practices, however the weed control reduces weed infestation after the hand weeding and inter-culture operation which tends to prove the less

weed density but the delay of the hand weeding due to climatic condition and other factor may cross out the critical period of weed competition and reduced the yield. The ground pod shell mulch too controls the weed infestation to half, but could not contribute higher yield. The causes might be the requirement of more energy in the decomposition of the shell in the soil which increases the C:N ratio and utilized the nutrient from the soil and reduced the yield. The pre-emergence herbicides pendimethalin and post emergence herbicides Pendimethalin+ Quizalofop ethyl at 100 g a.i. ha^{-1} had also less weed infestation and also reduced the infestation to half after application. The weed control method prolongs control to long time due to application of both types of herbicides.

Table 3. Effect of weed management practice in weed abundance in groundnut.

Weed management methods	B1	B2	N1	N2	T1	T2
Pendimethalin+HW	4.21(19.3)b	2.94(19.3)b	7.17(52.7)cd	3.52(12.3)cd	8.30(72)ad	4.47(21.3)cd
Metribuzin+HW	1.96(4)c	2.72(4)b	6.54(46)d	3.71(14.3)cd	6.77(50)d	4.53(21)cd
Propaquizafop at 100g	6.31(50.7)a	5.62(50.7)a	9.71(115)bc	7.73(63)a	11.75(165)bc	9.62(105)a
Quizalofop ethyl at100 g a.i	5.18(28.3)ab	3.55(28.3)b	13.17(175.3)a	5.21(31)bc	14.19(203)ab	6.22(45.3)bc
Pendimethalin + Propaquizafop	4.98(29)ab	2.72(29)b	7.99(69)cd	4.33(18)cd	9.38(98)cd	5.06(24.7)bcd
Pendimethalin+ Quizalofop ethyl at100 g a.i	4.32(20.3)b	1.95(20.3)b	6.66(50.7)d	3.19(10)d	7.86(71)d	3.61(13)d
Groundnut pod shell mulch	6.41(46)a	2.77(46)b	9.65(93)bc	4.37(18.3)cd	11.65(139)bc	5.09(25)cd
Farmer practice (1 hand weeding+ 1 IO)	5.27(34.3)ab	2.20(34.3)b	14.99(226.7)a	4.35(18)cd	16.04(261)a	4.83(22.7)cd
Control plot	4.27(18.3)b	3.64(18.3)b	12.23(150)ab	6.50(41.7)ab	12.93(168.3)b	7.45(55)ab
Grand mean	4.77	3.12 (27.8)	9.79	4.77	10.99	5.65
SEm (±)	0.465	0.613	0.926	0.564	0.949	0.779
LSD(0.05)	1.328*	1.752	2.648**	1.613**	2.712**	2.228**
CV(%)	23.7	48.1	23.1	29	21.2	33.8

*significant at 5% level of significance, ** highly significant at 1% level of significance. B1:Broad leaf before application, B2: Broad leaf after application, N1: Narrow leaf before application. N2: Narrow leaf after application, T1: Total weed species before application, T2: Total weed species after application.

Effect of weed management practice in economic analysis in groundnut

From economic view, application of the herbicides followed by hand weeding had higher cost of cultivation compared to application of the sole use of herbicides (both pre and post). The pendimethalin followed by hand weeding and other common cultivation practices cost NRS 1,19,610 followed by farmer practices where there is intense use of human labor due to severity of weed during time of the first weed management which may cross out the critical period. The cost of cultivation depends upon the cost of chemical used where Propaquizafop at100g and Quizalofop ethyl at 100 g a.i had higher price than other. Along the higher cost of cultivation, pendimethalin followed by hand weeding possess higher gross , net return and benefit cost ratio followed by Pendimethalin + Propaquizafop, Metribuzin+HW and Pendimethalin+ Quizalofop ethyl at 100 g a.i. ha^{-1}.

Table 4. Effect of weed management practice in economic analysis in groundnut

Treatment	Cost of cultivation (NRs)	Gross Return (NRs)	Net Return (NRs)	B:C
Pendimethalin+HW	119610	168080	48470	1.4
Metribuzin+HW	134130	152240	18110	1.13
Propaquizafop at 100g	111865	102080	-9785	-0.91
Quizalofop ethyl at 100 g a.i	114365	93600	-20765	-0.81
Pendimethalin + Propaquizafop	93675	114800	21200	1.22
Pendimethalin+ Quizalofop ethyl at 100 g a.i	96175	109520	13345	1.13
Groundnut pod shell mulch	113855	78240	-35615	-0.68
Farmer practice (1 hand weeding+ 1 IO)	161065	135600	-25465	-0.84
Control plot	68005	68800	795	1.01
Average	11257.2	113552.2	1143	

Conclusion

Manual weeding is one of the labor intensive practices whereas weed severity is another serious problem in groundnut production. The application of pre-emergence herbicides pendimethalin followed by hand weeding was found the best over other chemical use and intercultural operation. So, further research should be conducted in the large plot of farmers for the validation of these results and recommendation to the groundnut producers.

Conflicts of Interest

No conflicts of interest have been declared**.**

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