Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.5, No.17, 2015

A Review on Distribution, Biology and Management Practice of Russian Wheat Aphid Diuraphis noxia (Mordvilko) (Hemiptera:Aphididae), in Ethiopia

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1. INTRODUCTION

Ethiopian agriculture sector is predominantly important for the economy of the country which contributes about 50% to the total GDP and 90% of exports item (Haile and Raja, 2012).Several species of fruit crops are grown in Ethiopia including citrus, grape, pineapple, banana, papaya, avocado, mango and temperate fruits like peach and apple. The major reason for the low yield is that the crop is produced under numerous constraints, including insect pests (Alemu *et al*., 2012).

Russian Wheat Aphids (RWA) Diuraphis noxia (Mordvilko, Hemiptera: Aphididae) is a significant pest problem in many areas in the world (Anna-Maria *et al*., 2003).The Russian wheat aphid, *Diuraphis noxia* (Mordvilko) (Hemiptera: Aphididae), is the major insect that reduces barley yields, and it has a worldwide distribution including the Middle East, USA, South Africa, and Ethiopia .Understanding of the epidemiology of aphid-borne viruses is very important for the development of appropriate management strategies (Simon *et al.,* 2009**).** Russian wheat aphid is an important pest of wheat and barley in several countries of North Africa and West Asia, *e.g*., Morocco, Algeria, Tunisia, Ethiopia, Yemen, Turkey and Iran. Host plant resistance is the most economical and practical means of controlling this insect. Field The green peach aphid*, M. persicae* and the mustard aphid*, L. erysimi* were the most abundantly found aphid *L. erysimi* is an important pest of *Brassicaceae* including broccoli, cabbage, Chinese broccoli, daikon, mustard cabbage and radish, and is a vector of 10 non-persistent viruses (Blackman and Easton, 2000).

M. persicae is an established pest of pepper and found thorough out the world (Blackman and Eastop, 2000). It has been reported as a vector of EPMV from laboratory studies (Tameru, 2004) and is a well known vector of several other persistently and non persistently transmitted viruses. Among the identified aphid species, *Hayhurstia atriplicis* (L..)*, Hyperomyzus lactucae (L.), Schoutedenia ramulensis* Rübsaamen and *Tetraneura* spp. were not reported so far from Ethiopia. *Aphis gossypii* Glover, *M. persicae* and *M. euphorbiae* have also been reported earlier from Ethiopia on pepper (Simon *et al.,* 2009).

From the identified aphid species, *S. ramulensis* and *Tetraneura* spp. occurred less frequently than the other species in the collected samples *S. ramulensis* was recorded only from Awassa, while *Tetraneura* spp. from Ziway There is diverse cropping system at both the study locations, where maize, beans, pea, cabbage, onion,tomato, wheat, teff, barley and potato were the major crops found around the pepper fields (Simon *et al.,* 2009).

In Ethiopia, RWA was first reported in the Atsbi and Adigrat areas of Tigray in 1972 (Adugna Haile and Tesema Megnasa, 1987). RWA prefers barley and wheat, but also feeds on grass species when the main crops mature or are not available. RWA body length is about 2 mm and the colour varies from yellow-green to grey-green. The body of the RWA is spindle-shaped and can be distinguished from other cereal aphids by a projection above the last abdominal segment, the supracaudal process (Tesfaye and Christian, 2003). In Ethiopia, more than 38 species of insect pests have been reported to affect barley. Of these, eight are aphid species; the most important is the Russian Wheat Aphid (RWA) (*Diuraphis noxia* Mordvilko Homoptera: Aphididae). Mokrecki first described the RWA in 1900. It has been reported to be an indigenous aphid in southern Russia, Iran, Afghanistan and countries that border the Mediterranean (Bayeh, *et al.,* 2011).

Currently, *D. noxia* is a major pest in all barley-growing regions of Ethiopia, especially those at altitudes above 2,500 m a.s.l. where barley is the major food crop and is cultivated throughout the year (Alemu *et al*., 2014). In Ethiopia, RWA was first recorded on barley in the northern parts of the country in the drought period of the early 1970s (Bayeh, *et al*., 2011). The Russian wheat aphid is one of the greatest bio security threats to the grains in Ethiopia. The Ethiopian grains agriculture. Therefore, The objective of the Review to Determine the status of Distribution, Biology and management practice on Russian wheat Aphid *Diuraphis noxia* (Mordvilko) (Hemiptera: Aphididae), In Ethiopia. Such research includes some basic studies, as well as studies on host plant resistance, chemical screening, use of botanicals and natural products, and integrated control of RWA.

2. LIFE CYCLE AND DISTRIBUTION

2.1. Biology

Russian wheat aphid adults are small (1.6-2.1 mm long), spindle-shaped, and lime green in color. Shortened antennae and reduced cornicles at the end of the abdomen are distinguishing characteristics. Adults also have a "double cauda" from the side view (Erin W. Hodgson and Jay B. Karren, 2008). On depleting its food source, or under adverse environmental conditions, viviparous winged females are produced from RWA colonies. These winged forms can be borne long distances on wind currents to initiate new colonies. The RWA reproduces almost exclusively by parthenogenesis; very few males have been found (Burnett *et al.,* 1991). The Western wheat aphid, *D. tritici*, is similar in appearance and also damages wheat, but is covered with wax and has a regular cauda(Jay,2008). legs, antennae and cornicles are short compared to most other aphids. Viewed from the side, the terminal segment of the abdomen has a supracaudal structure that looks like a double tail. The greenbug is similar in color but the dark green stripe, long antennae and cornicles, which are often longer than the body, make it easy to distinguish from the Russian wheat aphid (Michaud and Phillip, 2005). Two forms of Russian wheat aphid (RWA) are found in the High Plains during the year: a wingless female and a winged female. It is difficult to determine if an individual aphid will be winged or wingless until it is near maturity. Wingless aphids that overwintered in the crop cause most severe spring infestations of winter grains. Winged aphids begin to appear in the High Plains in April and May and flights peak during July in most wheat-producing areas of the region (frank, 2006).The RWA is probably anholocyclic in Ethiopia as there is no severe cold season that may require sexual reproduction (Tesfaye and Christian,2003).

The Russian wheat aphid reproduces asexually. All aphids are female, and each gives birth to live daughters carrying embryonic granddaughters. This telescoping of generations, combined with rapid, asexual reproduction is the key to the explosive population growth achieved by many aphid species. Females reproduce asexually all year long and give birth to live young for 60-80 days. Russian wheat aphids seem to be more cold tolerant than other grain aphids, surviving exposure to -13°F. Temperatures greatly influence developmental rates, with optimal growth (86°F) generating adults in 7-10 days. Quick freezes and extended periods of snow cover are detrimental to winter survival (Erin and Jay, 2008). Russian wheat aphids produce several generations of winged forms every year. Although not strong flyers, winged aphids are migratory and move in search of actively growing plants. Peak aphid movement is in July, where they move from summer grain and begin to infest maturing winter wheat and wheat grasses. Volunteer wheat and barley also provide refuge between summer harvest and fall crop emergence (frank, 2006).

This species spends its entire life cycle on grains and grasses. It reproduces asexually and survives the winter as wingless nymphs or adults. It seems to be colder hardy than the other cereal grain species. Throughout the year, overcrowding and weather conditions may stimulate the production of winged forms, which are easily dispersed on wind currents. After a short feeding period on new plants, these females begin giving birth to wingless living young at a rate of 4-5 per day for about four weeks. The new young females can mature in as little as 7-10 days. Russian wheat aphids prefer to live in leaf whorls and tightly rolled leaves shortly after they begin feeding (Jay and Thomas, 1989).

2.1.1. Asexual Reproduction of Russian Wheat Aphids

Asexually reproducing populations of RWA are all female and adults give birth to live nymphs. After the fourth moult, aphids develop into either wingless (apterous) or winged (alate) adults. Wingless adults have a higher reproductive capacity and can produce 4-5 nymphs per day for a 3-4 week period. Reproduction rates increase as the temperature increases with generation times becoming shorter and more young produced by each female. In general, maturation is completed within 7-10 days (Plant Health Australiya, 2012).

2.1.2. Sexual Reproduction of Russian Wheat Aphids

In their native range, RWA are holocyclic, and therefore they can reproduce both sexually (usually for overwintering as eggs) and asexually (mostly during the warmer months). Where winter conditions are severe, RWA will over-winter as eggs. After mating, females lay 8-10 eggs on young cereal plants and die a few days afterwards. The eggs hatch in early spring and aphid population increases rapidly by parthenogenetic reproduction (Plant Health Australiya, 2012).

2.2. Distribution Russian wheat Aphids

RWA is currently distributed in most wheat producing countries around the world (Table 3). In general, RWA occurs in areas with low rainfall and has the ability to survive harsh winters.

Countries where RWA is known to occur Continent	Country
Asia	Afghanistan, China, Iran, Iraq Israel, Kazakhstan, Kyrgyzstan, Pakistan, Saudi Arabia, Syria, Turkey, Uzbekistan, Yemen
Europe	Bulgaria, Croatia, Czech Republic, France, Germany, Greece, Hungary, Italy, Macedonia, Moldova, Portugal, Russia, Slovakia, Spain, Ukraine, Yugoslavia,
Africa	Algeria, Egypt, Ethiopia, Kenya, Libya, Morocco, South Africa, Zimbabwe
North America	Canada, Mexico, USA
South America	Argentina, Chile

Source ;-(Plant Health Australiya, 2012).

The Russian wheat aphid (RWA), *Diuraphis noxia,* has only recently become a serious pest of wheat and barley. Its effects are being felt in many parts of the world. Originally collected and described in 1900 in the Caucasus area of the southern Soviet Union, it became a pest of wheat in South Africa in 1978(Burnett *et al.,,* 1991).

By 1980 it was recorded in Mexico and by 1986 it had reached Texas in the USA. Currently it is reported to be present in Canadian provinces of Alberta, British Colombia, and Saskatchewan and in most of the states of the western USA. It is also now found in Europe (Spain, France, Hungary), central Asia, the Middle East, Pakistan, Afghanistan, Africa (northern Ethiopia and South Africa), North America, and South America (Chile and Argentina) (Burnett *et al.,,*1991).

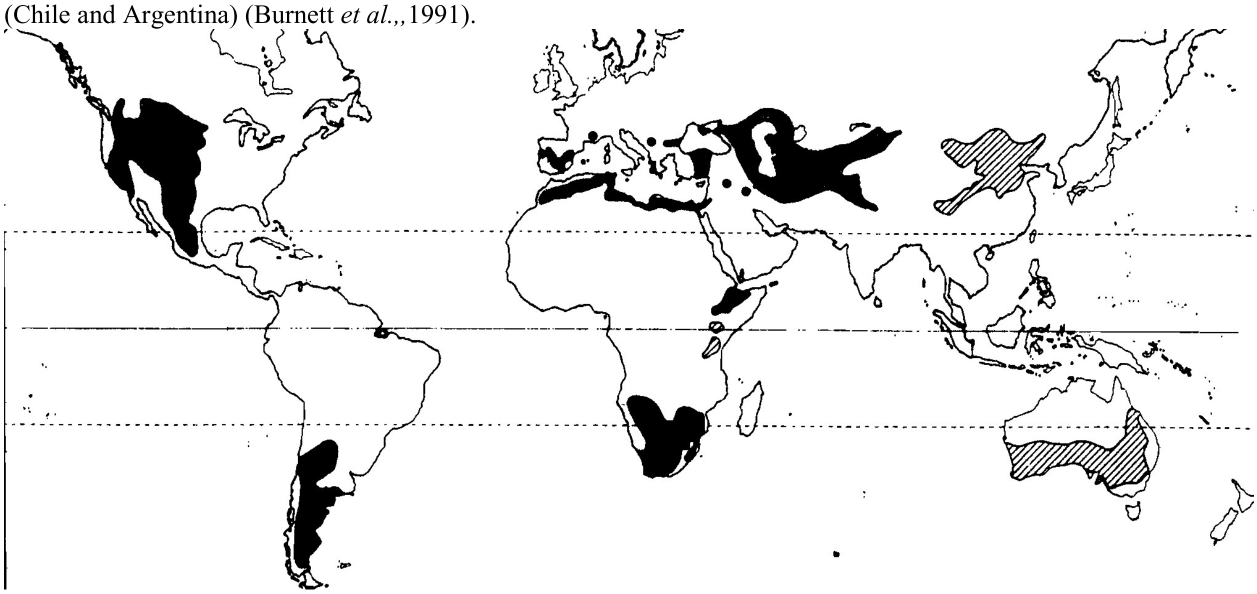


Figure 1. Areas of the world delineated by the CLIMEX model as favorable for the Russian wheat aphid *(Dluraphls noxla).* Source: Hughes ad Maywald (1990) cited by (Burnett *et al.,,* 1991).

Delineated areas with recorded occurrences of the aphid
• Aphid recorded, but not included in a delineated area
llllll Aphid not recorded, but conditions considered favorable

In Ethiopia, RWA infestation often starts at the early seedling growth stage, and as damage progresses the aphid pressure increases and the infestation may even persist after heading and result in severe crop damage or total crop failure This is mainly the case in the *Belg* season (February to May), which has low rainfall . The present RWA situation in Ethiopia is that the pest is abundant in certainplaces. Cyclical drought has been occurring over many years or erratic rainfall Distribution has been noted within a growing season (Bayeh,*et al.,*2011).Thus, in the *Belg* season, many farmers in Ethiopia have stopped growing barley. Infestations are particularly serious in the highlands (Tesfaye and Christian, 2003*).*It was found that the aphid population increases during the period when there is moisture stress. Starting at the time when sufficient rainfall is received, its population declines over time (Bayeh,*et al.,*2011).

3. ECOLOGY REQUIREMENT RUSSIAN WHEAT APHIDS

The geographical range of D. noxia (particularly the areas where it is a pest) is restricted to regions of low rainfall. Furthermore, even in areas with low rainfall, D. noxia is rarely a problem in irrigated cereals, and populations decline after heavy rainfall. These observations suggest that precipitation and/or humidity may directly or indirectly reduce survival or reproduction of D. noxia (www.cabi.org/isc).

4. DAMAGE AND YIELD LOSS

4.1. Damage

RWA, which primarily infests wheat and barley but also rye, triticale, and a range of grasses, feeds within tightly rolled leaves. The location of the feeding site makes it difficult for predators and parasitoids to find the RWA and also provides a degree of protection against contact insecticides. Typically in the field, damage symptoms are observed before the aphid is seen. The leaves of infested plants become tightly rolled and the plants develop a prostrate growth habit. Longitudinal chlorotic streaks develop on the leaves and some purple discoloration and necrosis may be observed. The spikes, frequently trapped in the flag leaf because of its tight curling, are often defonned as a result. Plants infested by RWA often exhibit symptoms typical of drought stress when soil moisture is not limited (Burnett *et al.,* 1991).

Plants infested by RWA often exhibit symptoms typical of drought stress when soil moisture is not limited (Burnett *et al.,* 1991).Feeding damage by *D. noxia* to plant leaves results in characteristic longitudinal white, yellow or red chlorotic streaks with a convoluted rolling of the leaf (Bouhssini *et al.*,2011). RWA can be found in winter wheat, usually on the younger leaves, from emergence in the fall to grain ripening. Aphid feeding prevents young leaves from unrolling. RWA colonies are found within the tubes formed by these tightly curled leaves. This not only makes it difficult to achieve good insecticide coverage, but also interferes with the ability of predaceous insects to reach and attack aphids (Frank, 2006).

Leaves infested by RWA have long white, purple or yellowish streaks. Under some conditions, infested wheat tillers have a purplish color. Heavily infested plants are stunted and some may appear prostrate or flattened. After flowering, some heads are twisted or distorted and have a bleached appearance. Heads often have a "fish hook" shape caused by awns trapped by tightly curled flag leaves. At this time most RWA are found feeding on the stem within the flag leaf sheath or on developing kernels (Frank, 2006).

4.2. Yield loss

A list is presented of 7 species of aphids that occur on wheat and barley in Ethiopia, of which *Diuraphis noxia* is the most damaging, causing up to 71% losses in yield. A list is presented of 27 food plants of the 7 aphid species in Ethiopia, together with a similar list of parasitoids (2 species of *Aphidius*) and predators (9 coccinellids and 1 syrphid) of these aphids. Preliminary screening in the field in 1985-86 indicated that 2 barley varieties may possess tolerance or resistance to *D. noxia* (Miller and Haile, 1988).

The major reason for the low yield is that the crop is produced under numerous constraints, including insect pests. A total of 38 insect pest species that attack barley were listed by (Alemu, 2014). The Russian wheat aphid causes severe damage to barley, in the highlands of Ethiopia. Little information is available on the control of this pest in Ethiopia. Barley yields are very low in Ethiopia, but many people believe that barley has a high yield potential (Lakew *et al.,* 1993). Cereals in Ethiopia are grown Under Divers vegetations, which have profound effects on diseases and populations of arthropod pests and natural enemies (Gordon *et al*., 1995).

Table2. Estimated of Preharvest Losses Due to Insect pests in Cereals

crops	Pest(s)	Loss (%)
Maize	Stalk Borers	0-100
	Termites	27
Sorghum	Stalk Borers	23-64
Barely	Barley Shoot fly	33
	Russian Wheat aphids	41-71
Wheat	Russian Wheat aphids	90-97
Teff	Red teff worm	33-45
	Grasshoppers	1-48
	Average	31-61

Source: - (Gordon.*et al*., 1995).

Reported yield losses caused by Russian Wheat aphids infestations have averaged around 50%:

30-60% → in winter wheat in South Africa (Du and Walters,1984).
40-70% → in barley in Europe (Miller and Haile,1988).
70% → in wheat in Ethiopia (Miller and Haile,1988).
50% → of attainable yield in the U.S. (Johnson,1990)

Source of: - Burnett *et al.,* 1991

Barley yield loss due to RWA damage at Chacha in North Shewa was estimated to be between 50% and

60%; this occurred during years of rainfall shortage, which favors the development of the pest population (Bayeh, *et al.,* 2011). Also Barley yield losses caused by RWA ranged from 41% to 79% in a previous study (Miller and Adugna, 1988).

Table 3 Barley grain yield losses caused by the Russian Wheat aphid in different parts of Ethiopia

Area	Location	Year of assessment	Recorded grain losses (%)
South Gonder	Lay Gayint	1995 and 1996	38.3
North Shewa	Chacha	1995 and 1996	86–100
North Shewa	Degem	1995 and 1996	9.6 and 68
North Wollo	Estaysh	1995 and 1996	35
	Debresina	1995 and 1996	26
	Hamisit	1995 and 1996	14
	Kon	1995 and 1996	21
South Wollo	Gimba	1995 and 1996	62
Tigray	May Chewand Alajie	1999 and 2000	9.6and40.30*

NOTES: * = For the two locations, respectively, over the 2 years
Sources (Bayeh,*et al.,*2011).

5. Economic Threshold

Deciding when to treat for Russian wheat aphids is based on economic thresholds. The economic threshold is where the damage from the aphid equals the cost of control. The economic threshold during the jointing (Michaud and Phillip, 2005).

Table -4 Recommended Economic Thresh Hold for cereals

Insect specie	Plant Specie	Recommended Economic Thresh Hold
Russian Wheat Aphids (RWA)	Cereals	✓ 10% of plants Infected with at least one aphids When First node visible ✓ 10% of tillers infested with 1 aphids when a tip of flag leaf just visible.

Source :- (Desmond *et al.,* 2010).

6. MANAGEMENT OPTION

When natural enemies and host-plant resistance fail, producers must rely on insecticides to limit aphid damage. Two insecticide options are currently available. One option is to use a seed treatment, which can provide early season protection but is only cost effective where there is a high probability of significant Russian wheat aphid activity. The other option is to use insecticides to reduce aphid numbers after populations have been detected in the field. Deciding when to treat for Russian wheat aphids is based on economic thresholds. The economic threshold is where the damage from the aphid equals the cost of control. The economic threshold during the jointing (Michaud and Phillip, 2005).

In order to support sustainable vegetable production, it is important to develop alternative methods of pest control. Neem products, being practically non-toxic to man and warm blooded animals and relatively harmless to beneficial insects, are very suitable for biological and integrated pest control programs. In addition in many third world countries, subsistence farmers who cannot afford to purchase synthetic pesticides and other chemical inputs produce vegetables (Mohamed Ahmed, 2000).

6.1. Host plants

A host range survey conducted in a part of the Amhara region identified 16 cultivated and wild grass species that host the RWA (Amare Andargie and Addisu Berhan, 1998). Russian wheat aphids remain on small grains or grasses all year long, and never move to a woody host as with other aphids. The most important host plants are wheat and barley, but cool season grasses. Nymphs and adults feed on plant phloem with a piercing-sucking stylet. Russian wheat aphids prefer to feed on foliage and grain spikes of actively growing plants. While feeding, these aphids can transmit a toxin that causes discoloration and distortion of the plant(Jay,2008).

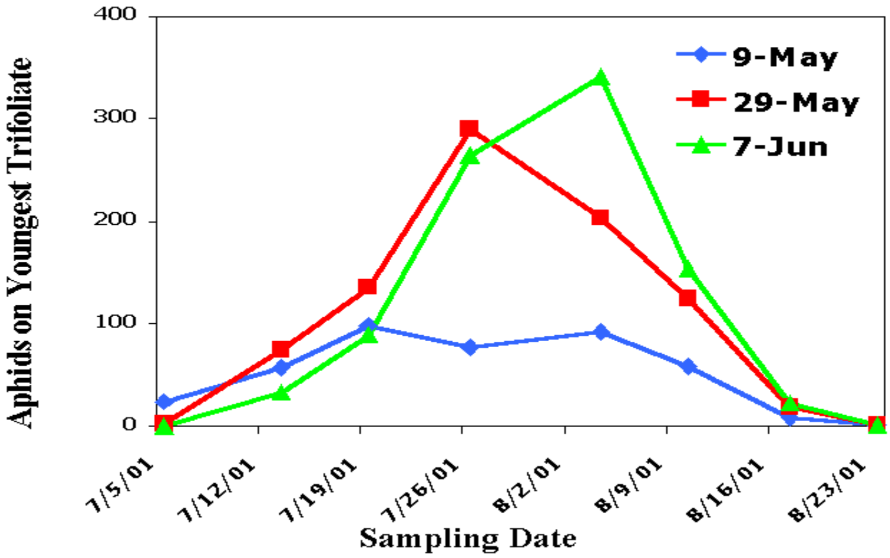
A variety of wild grasses can serve as host plants for the Russian wheat aphid and may be important for aphid survival when cereal crops such as wheat and barley are not available. In order to persist in a region, Russian wheat aphid must have host plants year round. Cool-season grasses important for this insect include wheat grasses, brome grasses, wild ryes and jointed go at grass (Michaud and Phillip, 2005).

6.2. Cultural Controls

6.2.1. Sowing Date trial

Cultural practices may play a key role in minimizing RWA damage and preventing early- season infestations. A sowing date experiment was conducted at Gimba and Gashena, in North Wollo, during the *Belg* season of 1996 Delayed planting increased aphid infestation and decreased grain and biomass yield, indicating the importance of early planting as a cultural control of RWA (Adane Tesfaye, 1998) as cited by (Bayeh,*et al.,*2011). Infestations are particularly serious in the highlands. The climate there is cool and barley is sown during late April to early May. Farmers prefer the late barley varieties as they give higher yields. However, this barley type is often subject to severe RWA damage, beginning in late May (Tesfaye Belay and Christian Stauffer, 2003).

The *Meher* season (June to October) is the most important season for barley production across the country. Early planting in May was abandoned by farmers in places such as the eastern parts of South Gonder, Wollo and North Shewa, due to a dry period in early June. The effect of N fertilization on the population of RWA was studied during the 1995 crop season in the highlands of Maichew. Results indicated that there was no significant variation between the different levels of fertilizers and the control. Seed dressing formulations applied systemically to the plants could reduce or prevent early crop infestation, but the available formulations are costly to use. Seed dressing chemicals could be effective in preventing RWA infestation during the *Meher* season, as this is when the RWA infestation mainly occurs (especially during the early part of the growing season) (Bayeh, *et al.,* 2011).



Higher populations of aphids are commonly observed on late-planted compared to early-planted.
Source of Graph riverdalealgservice.com

6.2.2. Resistant Varieties

Various genetic sources of resistance to Russian wheat aphids were identified in the late 1980s, and two were eventually incorporated into commercial wheat varieties. There was concern that breeding for plant resistance might make the aphids less suitable as food for natural enemies, but it actually can enhance biological control. Russian wheat aphids and green bugs grown on resistant varieties are as nutritious and acceptable for predators as those grown on susceptible varieties (Michaud and Phillip, 2005). Beside the above mentioned cultural practice varietal resistance is an important phenomenon in insect pest management. From a practical point of view, resistance is the ability of certain varieties to produce larger yield of good quality than other varieties at the same initial level of infestation and under similar environmental conditions (Rizwan, 2010). Host plant resistance is the most sustainable, cost-effective and environmentally safe way of controlling RWA (Bouhssini *et al.*, 2011).

Table 4 barley lines with a good level of resistance against RWA (*D. noxia* Mord.) with local and susceptible checks in the 1999 and 2000 *Belg* seasons at Chacha

Barley line	1999 *Belg* season				
	I (%)	LC	LR	DH (%)	DTH
ROO2	10	1	1	3	111
ROO4	8	1	0	2	104
RO31	26.5	1	1	2	114
RO22	16.5	1	0	1	113
RO26	21	1	0	2.5	119
RO23	12	0	0	1	111
RO18	14	1.5	1	3	120
Local check (Kessele)	49	5	5	13	90
Susceptible check (3284-9	52	6	5	24	90

NOTES: I = percentage infestation; LC = leaf chlorosis using 0–9 scale scoring; LR = leaf rolling using 0–9 scale scoring; DH = percentage deformed head; DTH = days to heading.
Sources :- (Bayeh, *et al.,* 2011**).**

Resistant varieties are the most effective means of RWA management and should be used if there is a variety available that does well in your area. Russian wheat aphid resistant varieties may still be used if they perform well in a given area, however, they likely will not provide any useful resistance (Frank, 2006). The solution that farmers have adopted in the RWA hot spots of North Shewa is to grow early maturing varieties of barley by planting them in late June. The alternative, which requires less investment from the farmers and does not need special skill to implement, is sustainable and environmentally friendly, namely the use of RWA-resistant cultivars (Bayeh, *et al.*, 2011).

Although resistant varieties provide the most effective RWA control, several other practices can provide additional control of the aphid. These practices should also help with other pest problems and make good agronomic sense as well.

1. Control volunteer wheat and barley. Although many grass species help RWA survive the summer, volunteers are the most important source of infestation for the new crop in the fall. Try to have a three week volunteer free period prior to emergence of fall seedlings.
2. Adjust planting dates. Plant winter wheat as late as possible in northeastern, southwestern and western Colorado, western Nebraska and Wyoming. Recommended planting dates for southeast Colorado are more variable. Spring grains should be planted as early as possible.
3. Produce a healthy, stress-free crop. RWA often gets its start in stressed fields or stressed portions of fields and causes relatively more damage to stressed plants. Test the soil and fertilize accordingly. Plant certified, treated seed. Select a variety that is well adapted to local growing conditions (Frank, 2006).

6.3. Chemical control

Rolled leaves are a common damage symptom indicating host plant susceptibility. A characteristic behaviour of *D. noxia* is to feed and develop inside the rolled leaf whorl confining insecticide options to active ingredients with systemic action able to penetrate the rolled leaf. Systemic insecticides containing disulfuton, dimethoate and demeton-S-methyl; or vapour-action insecticides with chlorpyriphos or parathion have proven to be effective against RWA (Robert, 2008). In the highlands of Ethiopia, most farmers live at a subsistence level and so they cannot afford the use of insecticides against RWA. Thus, control management should mainly focus on cultural controls and host-plant resistance (Tesfaye Belay1 and Christian Stauffer, 2003***).*** Due to the subsistence nature of the farming system Ethiopia, farmers have not adopted the use of insecticides. However, spraying insecticides may not be that effective against RWA due to the rolled leaves of barley, which prevent direct contact (Bayeh*, et al.,* 2011).

Table 5 Results of combined analysis over location on the effect of seed dressing insecticides on RWA Infestation and yield of barley at Kotu and Chacha during the 1998 *Belg* season

Insecticide	Rate(g a.i./kgseed)	Damage score (0–9 scale) at three growth stages				Yield (q/ha)	
		Tillering	Booting	Heading	Mean	Straw	Grain
Imidacloprid 70 WS	2.5	1.2	1.3	1.8	1.5	27.2	10.2
Promet 400 CC	5	4.7	5.0	5.2	5.0	30.6	10.1
Promet 400 CC	10	4.7	5.3	5.7	5.2	24.6	7.5
Promet 400 CC	20	4.7	5.3	6.0	5.4	23.7	7.5
Cruiser 70 WS	0.5	2.2	2.7	3.5	2.8	32.3	7.5
Cruiser 70 WS	0.75	1.9	2.7	3.5	2.6	32.0	11.5
Cruiser 70 WS	1	1.7	2.5	3.2	2.4	30.7	10.8
Cruiser 35 FS	1	2.0	2.8	3.3	2.7	22.8	8.5
Cruiser 35 FS	1.5	2.0	2.2	2.8	2.3	26.1	10.6
Cruiser 35 FS	2	1.7	2.2	2.7	2.2	30.2	8.9
Apron star 42 WP	2.5	3.0	4.0	4.7	3.9	29.6	8.0
Apron star 42 WP	3.5	3.2	3.8	4.0	3.7	34.1	8.0
Apron star 42 WP	5	1.2	1.7	2.2	1.7	37.6	11.3
Gaucho raxil	1.5	1.5	2.0	2.7	2.1	28.5	9.0
Gaucho raxil	2	1.5	2.3	3.0	2.3	26.8	8.8
Gaucho raxil	2.5	1.5	2.0	2.7	2.1	23.6	9.6
Untreated check		5.5	6.0	7.0	6.2	16.6	5.0

CV (%) 26.3 25.8 17.3 12.4 23.6 33.7
LSD (P<0.05)" 1.1 1.3 1.04 0.9 10.8 5.0
The highest rate controlled aphid Damage more and increased grain yield (Addisu Birhan and Tadess Gebremedhin, 1999).
Chemical control of Russian wheat aphid will probably not be necessary on resistant wheat varieties, but may still be necessary on susceptible types.
Table 6 Treatment guidelines for Russian wheat aphid by crop stage.

Crop Stage	Level at which aphids should be treated Fall
Any growth stage	10-20% damaged plants Spring
Re growth to early boot	5-10% damaged and infested tillers
Early boot to flowering	10-20% damaged and infested
After Flowering	More Than 20% damage and infested tillers

Source of Figure;- (Addisu Birhan and Tadess Gebremedhin, 1999).

6.4. Biological control

Biological control is the use of beneficial organisms to help control pest organisms. These beneficial organisms are often referred to as “biocontrol agents” or “natural enemies.” Biological control is difficult as the efficiency of most of the existing natural enemies is low at the early stage of the crop (Adugna Haile and Tesema Megnasa, 1987)

Department of Agriculture mounted an unprecedented, far-reaching program to explore the ancestral range of 3 the Russian wheat aphid and find natural enemies. At least 120 scientists from 20 countries participated in the program, which imported more than 12 million beneficial insects of at least 24 species (Michaud and Phillip, 2005).

Biological control or biocontrol constitutes a deliberate attempt to usenatural enemies either by introducing new species into the environment of the pest orby increasing the effectiveness of those already present Traditionally, this methodemployed to control insect pests by parasitoids, predators and pathogens and amongthese we rely mostly on the predators(Rizwan, 2010).

Predators and parasitoids that attack other grain aphids also feed on the Russian wheat aphid, but not all are effective at reaching them in rolled leaves (Michaud and Phillip, 2005).

- The key predator of green bug in the region, is one of the most important natural controls
- The seven-spotted lady beetle, Coccinella sepempuncata, is common in wheat fields in early spring and may play a role in reducing Russian wheat aphid numbers.

- Small ladybeetle species in the genus Scymnus have larvae with distinctive waxy filaments and can also be found feeding in Russian wheat aphid colonies
- Hover fly
- Scymnus beetle

Various entomopathogenic fungi can cause diseases in Russian wheat aphids, but most require substantial humidity to be effective, which makes them a less likely cause of death in arid regions where the aphid is most prevalent (Michaud and Phillip, 2005).

6.5. Integrated Russian Wheat Aphid Management

The Russian wheat aphid, *Diuraphis noxia* (Mordvilko) (Hemiptera: Aphididae), is the major insect that reduces barley yields, and it has a worldwide distribution including the Middle East, USA, South Africa, and Ethiopia.It is therefore necessary to monitor the biotypic status of *D. noxia* in Ethiopia as a component of a comprehensive integrated pest management approach (Alemu *et al*., 2014).Grassland management and crop rotation can go some way to reoucing reservoirs of the aphid. However, host plant (Burnett *et al.,* 1991).

The use of resistant or tolerant host plants, as well as effective, economical and available seed dressings or spray formulations of insecticides, are possibilities in the management of RWA. Under small-scale farming conditions, the following are usable technologies for the management of RWA listed (Bayeh*, et al.,* 2011).

1. Clearing broom grass in and around barley fields is a good cultural practice for reducing damage by RWA.
2. Early planting of barley in the *Belg* season in North Wollo.
3. Promoting the use of 3296-15, a proven RWA-resistant cultivar.
4. Using Cruiser 70 WP, Furathicarb 400 CS and Imidacloprid 70 WS at rates of 75, 74 and 88.2 g Per 100 kg barley seed as effective seed treatments against RWA.
5. Using Dimethoate 40% EC at a rate of 1.5 L/ha to effectively control RWA on barley.
6. Using Pirimiphos-methyl 50% EC at 1 L/ha to effectively control RWA on barley.
7. Early sowing combined with a one-off spraying of Pirimiphos-methyl 50% EC to effectively control RWA on barley.
8. Combining a tolerant line (3296-15) with dimethoate, and complementing the Spraying with fermented cow urine or tobacco extract, to effectively control the RWA.

Evaluation of some selected village-available botanicals for the control of RWA conducted by the Sirinka Research Centre in 1998 showed that spraying tobacco, fermented cow urine resulted in good pest control, and there was more than a 50% grain yield advantage in barley over the untreated check (SiARC, 1998).

The yield losses from wheat stem sawfly alone could exceed 75 percent when resistant varieties are not used. The resistance of wheat cultivars to natural infestation by aphids was evaluated by adult weight, number of the pigmented eyes embryos inside the adult and the portion of the flag leaves colonized. The main resistance mechanism was thought to be antibiosis though non-preference may also have occurred.

Using host plant resistance instead of chemical control or as a component of IPM (Integrated Pest Management) certainly has an edge over the later as being aneconomical, effective through growing season and environmentally safe. It has,therefore, been proposed to investigate the various varieties of wheat for theirresistance/ susceptibility to various species of aphids under fields as well as underlaboratory conditions(Rizwan,2010).

The aphid problem can be tackled with application of commonly usedinsecticides, but the drawback lies with their indiscriminate use resulting in problemsof health hazards, environmental pollution and development of resistance in insectsagainst insecticides Therefore it is advised that suchvarieties should be screened out which are resistant against aphid attack. Furthermorewheat is a major food staple and use of any chemical insecticide will lead to the health hazards and entry of various chemicals into food chain (Rizwan, 2010).

By using chemical insecticidesnatural balance also become disturbed, especially between predators and parasites.Therefore it is advised that biological control should be practiced to avoid all theseproblems(Rizwan, 2010).

7. SUMMERY AND CONCLUSION

In Ethiopia, more than 38 species of insect pests have been reported to affect barley. Of these, eight are aphid species; the most important is the Russian Wheat Aphid (RWA) (Diuraphis noxia Mordvilko Homoptera: Aphididae. In Ethiopia, RWA was first recorded on barley in the northern parts of the country in the drought period of the early 1970s. At present, it is found in all barley growing areas of the country, with varying degrees of barley destruction. Drought stress and aphid infestations are two factors that individually cause large yield reductions in cereal grains. Devastating yield losses when these two factors occur in succession indicate a possible synergistic interaction between aphid infestation and drought stress. This may explain the catastrophic yield.

Barley research and development in Ethiopia188 losses experienced by farmers in the RWA hot spots of Ethiopia when rainfall shortage has coincided with RWA infestation. As well as inducing drought-stress symptoms, the other biological effects it can have include: chloroplast breakdown caused by stylet-injected toxins; and rolling of leaves, including the flag leaves, resulting in contorted “goose neck” grain heads, which are sterile.

In Ethiopia, RWA infestation often starts at the early seedling growth stage, and as damage progresses the aphid pressure increases and the infestation may even persist after heading and result in severe crop damage or total crop failure. This is mainly the case in the Belg season (February to May), which has low rainfall. Early planting in May was abandoned by farmers in places such as the eastern parts of South Gonder, Wollo and North Shewa, due to a dry period in early June. This dry period, as mentioned earlier, favours the insect. The solution that farmers have adopted in the RWA hot spots of North Shewa is to grow early maturing varieties of barley by planting them in late June. This delayed sowing helps the crop to escape much pest damage; however, as observed, the yields decrease correspondingly (Bayeh and Tadesse, 1996). Due to the subsistence nature of the farming system in these areas, farmers have not adopted the use of insecticides. However, spraying insecticides may not be that effective against RWA due to the rolled leaves of barley, which prevent direct contact. Seed dressing formulations applied systemically to the plants could reduce or prevent early crop infestation, but the available formulations are costly to use. Seed dressing chemicals could be effective in preventing RWA infestation during the

Meher season, as this is when the RWA infestation mainly occurs (especially during the early part of the growing season). The alternative, which requires less investment from the farmers and does not need special skill to implement, is sustainable and environmentally friendly, namely the use of RWA-resistant cultivars. By focusing on the development of resistant strains of barley, other management methods also need to be developed in order to develop integrated management systems against RWA.

Knowing the enemy is the first step toward better control of pest like Aphids Specise and minimizing the gap between actual and attainable yields. This entails understanding the ecological conditions that favor Russian Wheat Aphids variability across geographical areas, including their evolution over time. Resistance breeding remains essential and it is the cornerstone of economical and ecologically friendly approaches to limit disease outbreaks. Identification and characterization of sources of resistance are critical as is ensuring that broad and diverse sources of resistance are effectively employed. Genetic resistance is the main method for controlling obligate RWA and Integreted RWA Management. However, effective RWA control requires that durable, race nonspecific resistance is incorporated into high yielding genotypes. Integrated efforts to identify and incorporate resistance with international organizations, national programs, and advanced research institutions will enable all parties to harness resistant germplasm more rapidly and have it adopted more widely.

In addition to identifying and incorporating genetic resistance, improved crop management will be necessary to control non-obligate parasites. This again assumes an understanding of the epidemiology—environmental conditions change both annually and on a long-term basis—and incorporating cropping practices that will reduce the effects of stress, which influences susceptibility to some RWA.

RWA were found to be major, which needs to take action. RWA are the most important Aphid. aphids are important insect pest and farmers were using some cultural practice to control.. Moreover, for major pests, which could not found enough information about their biology, ecology and the economic thresholds need to be studied and have been given strong attention towards these RWA in designing control strategies. No Strong monitoring strategies should be designed since one minor pest at a time may be major pest on another time, due to sporadic nature of pests. Immediate control measure has to be suggested.

8. RESEARCH GAP

At present in Ethiopia, RWA found in all barley growing areas of the country, with varying degrees of barley destruction. In Ethiopia, RWA infestation often starts at the early seedling growth stage, and as damage progresses the aphid pressure increases and the infestation may even persist after heading and result in severe crop damage or total crop failure. Barley yield loss due to RWA damage at Chacha in North Shewa was estimated to be between 50% and 60%. RWA situation in Ethiopia is that the pest is abundant in certain places. Cyclical drought has been occurring over many years or erratic rainfall distribution has been noted within a growing season. The Meher season (June to October) is the most important season for barley production across the country. The solution that farmers have adopted in the RWA hot spots of North Shewa is to grow early maturing varieties of barley by planting them in late June. By focusing on the development of resistant strains of barley, other management methods also need to be developed in order to develop integrated management systems against RWA

9. REFERENCE

1. Addisu Birhan & Tadesse Gebremedhin. 1999. Imidacloprid as a seed treatment for the control of Russian Wheat Aphid (*Diuraphis noxia*) (Homopetra: Aphididae) on barley. *Pest Management Journal of Ethiopia,*

3: 13–21.
2. Alemu A., Tesfay B., and Temam H., 2014.Variation between Ethiopian and North American barley varieties (*Hordeum vulgare*) in response to Russian wheat aphid (D*iuraphis noxia*) populations. Journal of Insect Science: Vol. 14 | Article 40. Haramaya University, Haramaya, Ethiopa.
3. Anna-Maria Botha, Youchun li, and Nora l. v. Lapitan, 2006. Cereal host interactions with Russian wheat aphid: A review. Journal of Plant Interactions,; 1(4): 211_222
4. Bayeh Mulatu, Tesfaye Belay, Asmare Dejen, Yeshitila Merine and Birhanu Hunegnaw,2011.Research achievements for the Russian Wheat Aphid (Diuraphis noxia Mord.) On barley in Ethiopia. Holetta Agricultural Research Centre, Ethiopia.
5. Burnett, PA., J. Robinson, B. Skovmand, A. Mujeeb-Kazi, and G. Hettel. 1991. Russian Wheat Aphid Research at CIMMYT. Current Status and Future Goals. Wheat Special Report No. 1. Mexico, D.F.: CIMMYT.
6. Desmond Jimenez, Giselle Janssen, Dennis Long, Brett Highland, Tara Lu, Gerardo Bueno,2010. Methods of inhibiting, preventing, killing and/or repelling insects using simulated blends of chenopodium extracts. U.S. Provisional.
7. Erin W. Hodgson and Jay B. Karren, 2008. Russian wheat aphid Published by Utah State University Extension and Utah Plant Pest Diagnostic Laboratory. Department of Agriculture, Noelle Cockett, Vice President for Extension and Agriculture, Utah State University UPPDL, 5305 Old Main Hill, Logan UT 84322-5305.
8. Miller, R. H. and Haile, A., 1988. Russian wheat aphids on barley in Ethiopia. CAB Direct, RACHIS 1988 Vol. 7 No. 1-2 pp. 51-52.
9. Ferit Turanli , Astrid Jankielsohn , Alexey Morgounov and Mehmet Cakir,2012 .The distribution
10. of Russian Wheat Aphid, *Diuraphis noxia* (Kurdjumov) (Hemiptera: Aphididae) in Turkey.
11. African Journal of Agricultural Research Vol. 7(39), pp. 5396-5404.
12. Frank B. Peairs, Gary L. Hein, & Gary J. Brewer, 2006.Russian Wheat Aphid.Highplains Integreted Pest Mangement. Western Region IPM Center, EPA Region Vlll, National Plant Diagnostic Network South Dakota State University UPPDL, 5305 Old Main Hill, Logan UT 84322-5305.
13. Haile Michael and N. Raja,2012.Evaluation of *Melia azedarach* Linn *Croton macrostachys* Hochst and *Schinus molle* Linn Plant Extracts against Cabbage Aphid *Brevicoryne brassicae* Linn and their Natural Enemies *Diaeretiella rapae* (Mintosh) and *Hippodamia tredecimpunctata* Linn.Asian Journal of Agricultural Sciences 4(6): 411-418, ISSN: 2041-3890
14. H.Gordon, A.Chiri andT.Abate, 1995. Environmental and Economic Review of Crop Protection And Pesticide Use in Ethiopia. Winrock International Environmental AllianceArlington,Virgina,U.S.A.
15. Jay B. Karren, 2008. Russian wheat aphidPublished by Utah State University Extension and Utah Plant Pest Diagnostic LaboratoryENT-67-08.
16. J.P. Michaud and Phillip E. Sloderbeck, *Russian Wheat Aphid*, Kansas State University, May 2005.Jay B Karren, Thomas A. Reeve,1989.Russian Wheat Aphid in Utah.Extention Entomogy Departement of Biology,Logan,UT 84322-5349.
17. Miller, R.H. & Adugna Haile. 1988. Russian wheat aphid on barley in Ethiopia. *Rachis*,7: 51–52.
18. Mohamed Ahmed, 2000.studies on the control of insect pests in vegetables (okra, tomato, and onion) in sudan with special reference to neempreparations. institute of phytopathology and Applied zoology justus-liebig-university of giessen.
19. Mohammed D., Ferdu A. , Difabachew B., Bezawork M. and Mengistu .Review of Entomological Researches on Fruit Crops in Ethiopia. Ethiopian Institute of Agricultural research P.O.Box 2003, Addis Ababa, Hawassa University P.O.Box 5 Awassa, Upper Awash Agro Industry Enterprise, P.O.Box 12624 M. El Bouhssini , F. C. Ogbonnaya , H, Ketata1, M. M. Mosaad , K. Street , A. Amri , M. Keser1, S.
20. Rajaram , A. Morgounov , F. Rihawi1, A. Dabus1 and C. M. Smith.Progress in host plant resistance in wheat to Russian wheat aphid (Hemiptera: Aphididae) in North Africa and West Asia. AJCS 5(9):1108-1113 (2011)
21. Plant Health Australia 2012.Russian wheat Aphid Diuraphis noxia threat specific contingencyplan industry biosecurity plan for the grains industry.
22. Robert c.2008. The influence of environment on the expression of Russian wheat aphid; *diuraphis noxia* (kurdjumov) resistance. Department of plant sciences, university of the Free State, bloemfontein, south Africa.
23. Tesfaye Belay. 2003. Biotypic status of the Russian wheat aphid, *Diuraphis noxia*, in correlationto resistant barley lines in the highlands of Tigray, Ethiopia. Dissertation am Institut fur Forstentomologie, Forstpathologie & Forstschutz, Vienna, Austria.
24. SiARC. 1998. Comparison of some village-available insecticides for their effectiveness in controlling the RWA, *Diuraphis noxia* Mordvilko on barley. SiARC Progress Report forthe period June 1997 to April 1998.

SiARC, Sirinka, Ethiopia.

25. Rizwan Rasool, 2010. Effect of morphological plant characters towards resistance against aphidson wheat department of zoologygc university, Faisalabad.
26. Simon A., Tameru A. and Ferdu A. 2009.Diversity of aphids in the central rift valley of Ethiopiaand their potential as vectors for Ethiopian Pepper Mottle Virus (EPMV).Journal of Entomology and Nematology Vol. 1(1), pp. 001-006, May, 2009
27. Smith CM , Belay T, Stauffer C, Stary P, Kubeckova I, Starkey S2004.Identification of Russian wheat aphid (Homoptera: Aphididae) populations virulent to the Dn4 resistance gene. J Econ Entomol. Jun;97(3):1112-7.
28. Tesfaye Belay and Christian Stauffer2006. Biotypic and genetic variability in the Russian Wheat Aphid (*Diuraphis noxia* (Mordvilko)) (Homoptera: Aphididae). Barley Research and Development in Ethiopia. Holetta Agricultural Research Centre, Ethiopia 28–30 .
29. Wikipedia, the free encyclopedia www.cabi.org/isc

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